

**§15.247(a)(2) & §15.407 – 6 DB BANDWIDTH and 26 DB BANDWIDTH**

**Standard Applicable**

According to §15.247(a)(2), for direct sequence systems, the minimum 6dB bandwidth shall be at least 500 kHz. According to §15.407, 26dB Bandwidth should be shown.

**Measurement Procedure**

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 6 dB from the reference level. Record the frequency difference as the emission bandwidth. (6 dB bandwidth for DTS)
4. Same as (3) except 26 dB. (26dB bandwidth for UNII)
5. Repeat above procedures until all frequencies measured were complete.

**Equipment Lists**

Manufacturer	Model No.	Description	Calibration Date
HP	8565EC	Spectrum Analyzer	2003-01-22

**Measurement Result**

**Environmental Conditions**

Temperature:	12° C
Relative Humidity:	48%
ATM Pressure:	1100 mbar

**Test Result for 802.11b (15.247)**

Channel	Frequency (MHz)	Measured (MHz)	Standard (kHz)	Result
Low	2412	10.25 MHz	≥ 500	Compliant
Mid	2442	10.33 MHz	≥ 500	Compliant
High	2462	10.50 MHz	≥ 500	Compliant

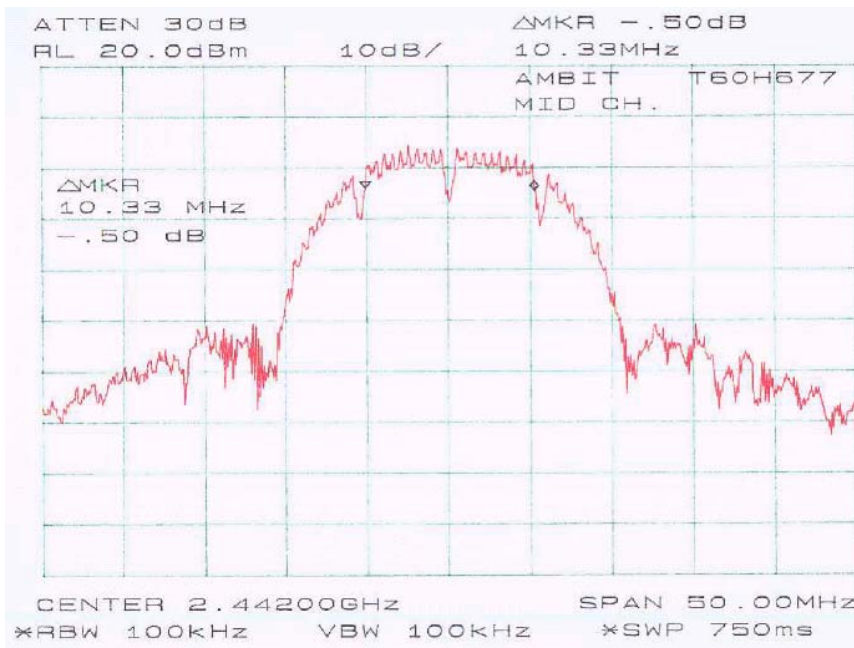
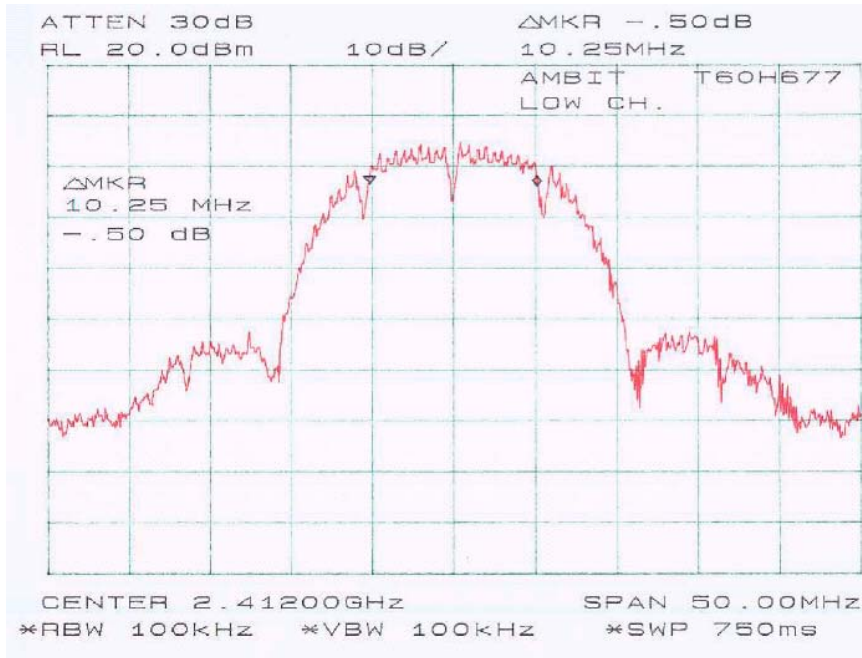
**Test Result for 802.11g (15.247)**

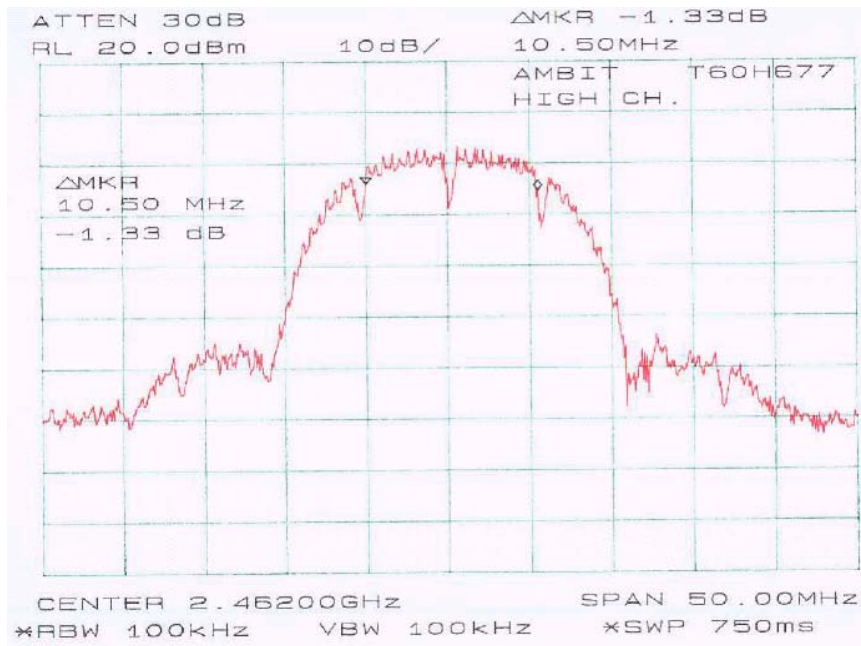
	Frequency (MHz)	Measured (MHz)	Standard (kHz)	Result
J1 Port	2412	16.83	≥ 500	Compliant
	2442	16.92	≥ 500	Compliant
	2462	16.83	≥ 500	Compliant

**Test Result for 802.11a MHz Band (15.407)**

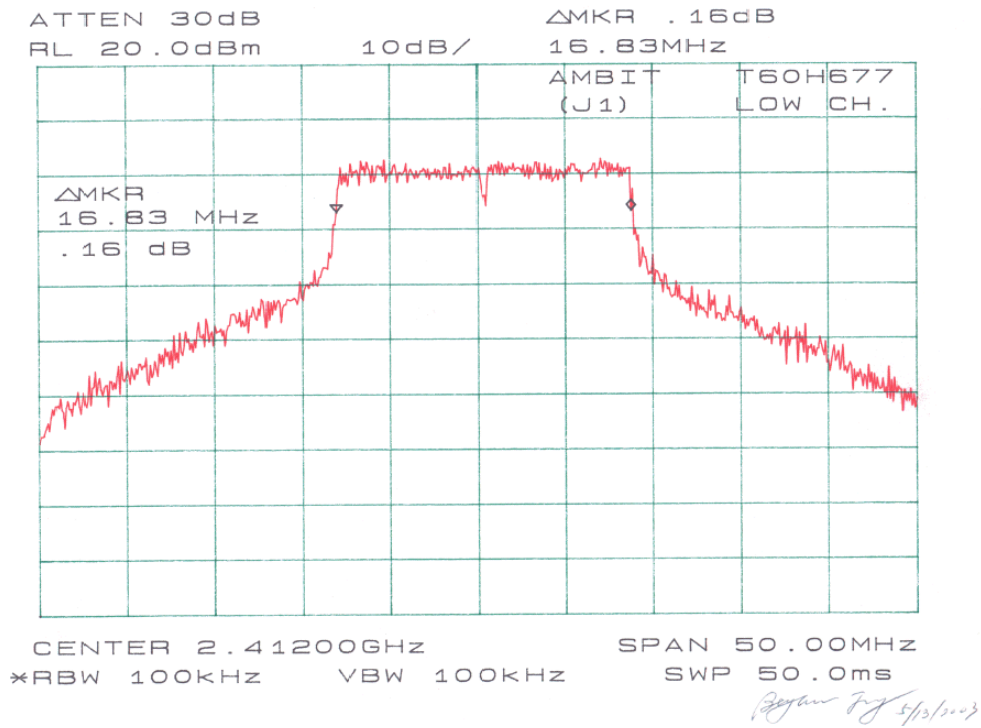
Band	Channel	Frequency (MHz)	Measured (MHz)
Low	Low	5150	23.33
	Mid	5200	23.25
	High	5250	23.58
Mid	Low	5250	23.83
	Mid	5300	23.08
	High	5350	23.83
High	Low	5725	23.00
	Mid	5775	23.75
	High	5825	23.50

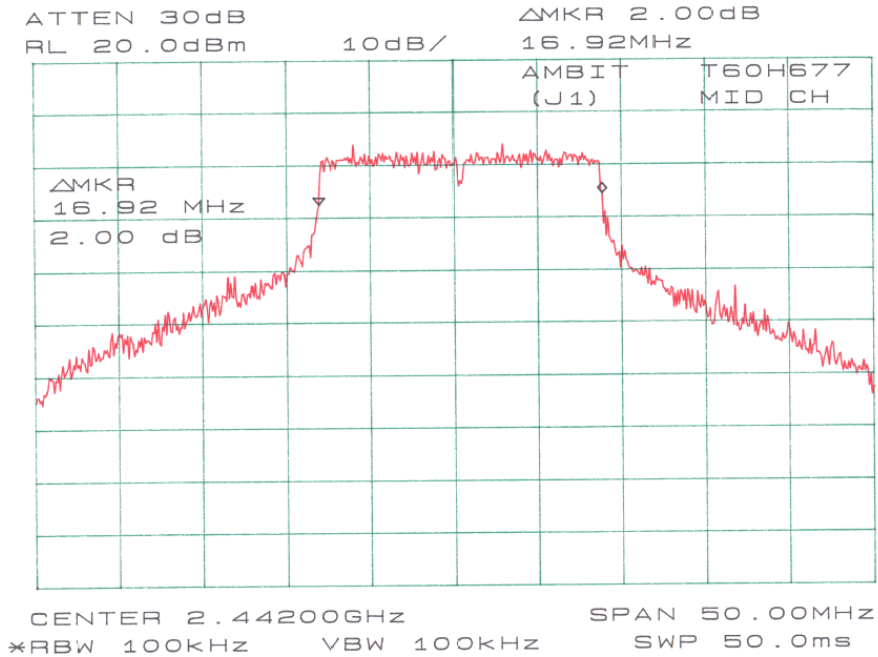
Plots of 6dB Bandwidth for 802.11b (15.247)



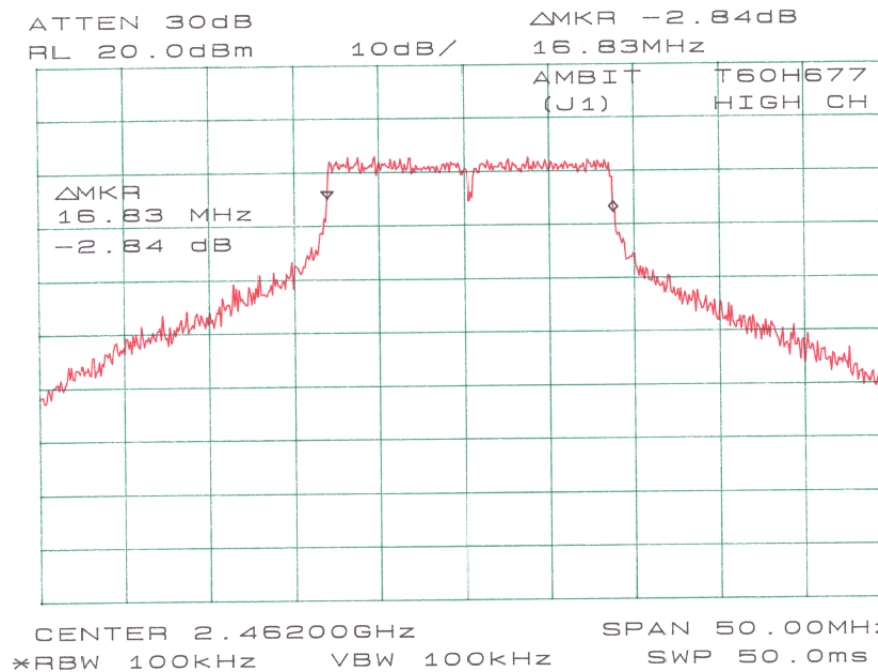


Plots of 6dB Bandwidth for 802.11g (15.247)



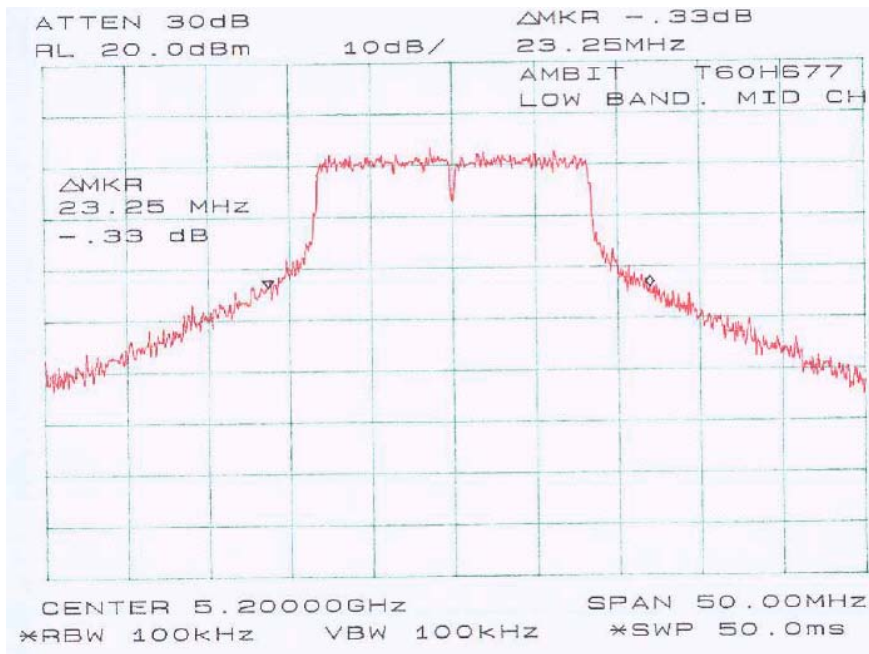
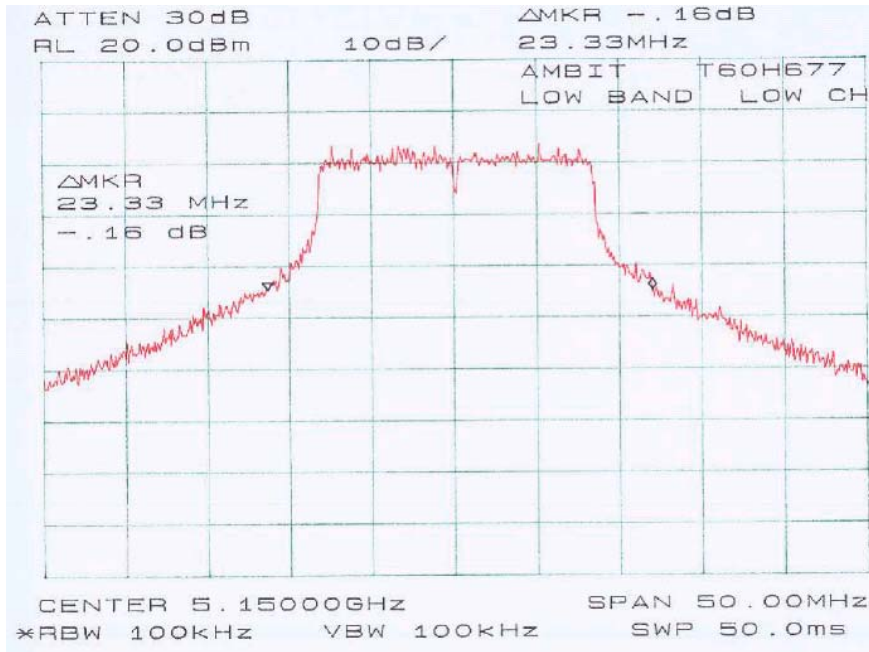


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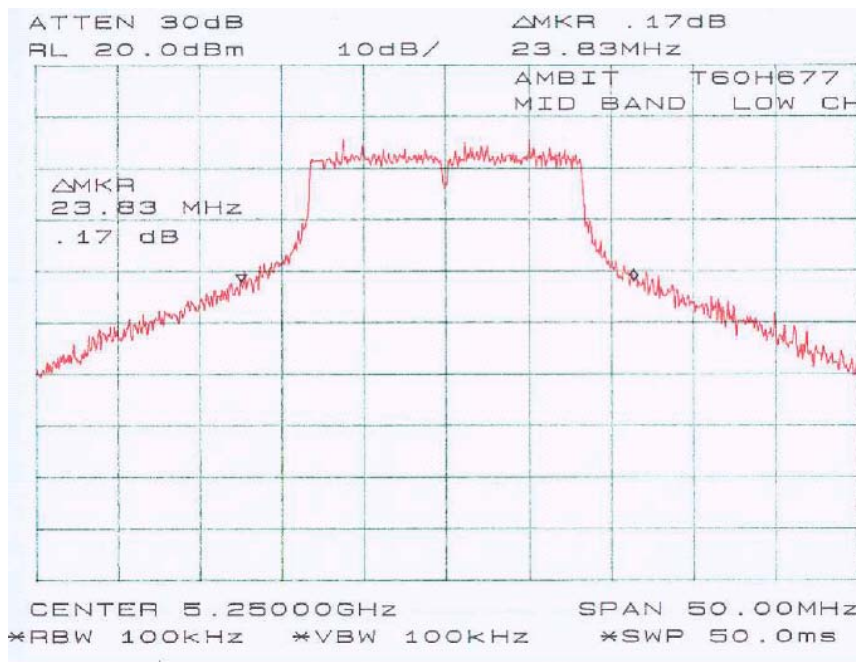
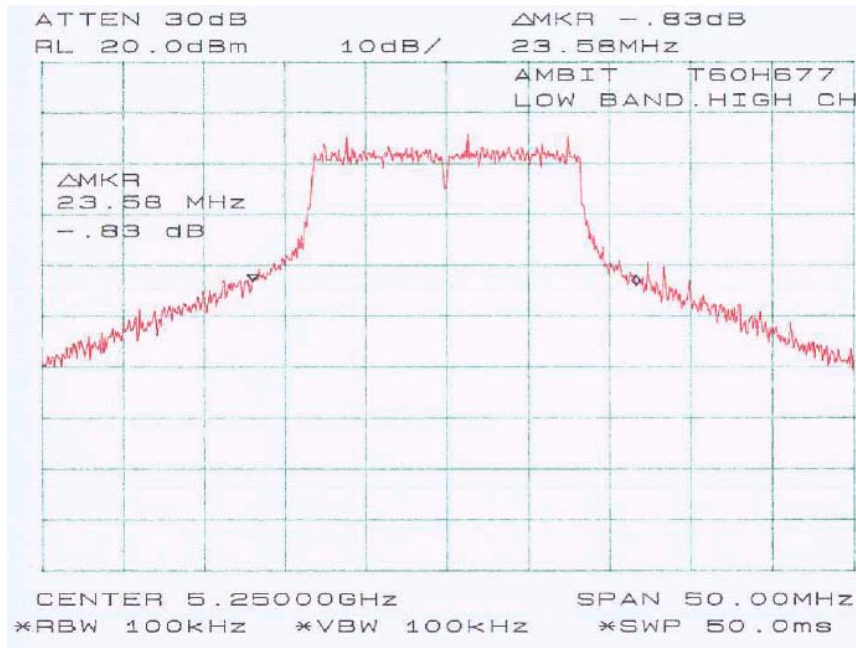


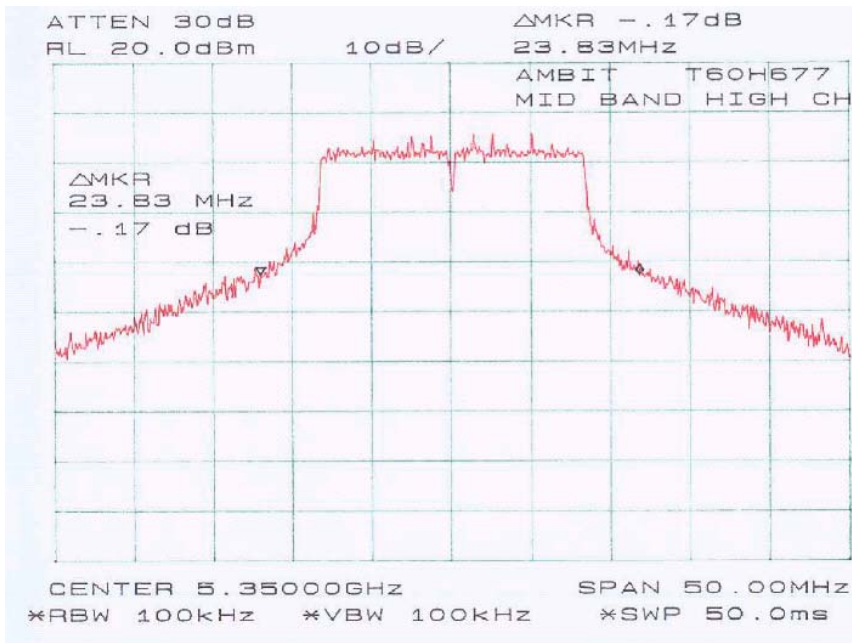
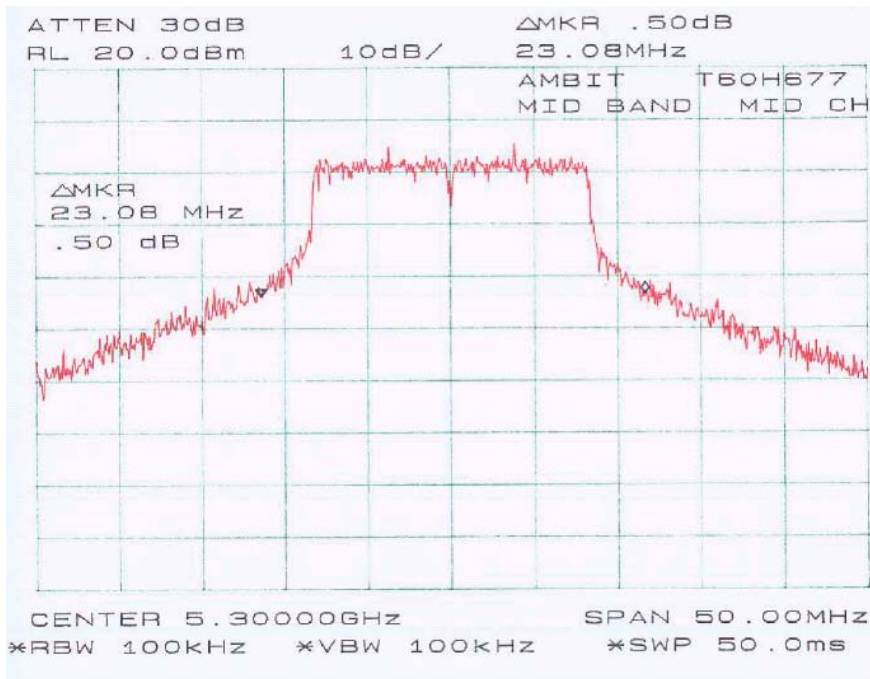
*Bojan Fry 5/13/2003*

Plots of 26dB Bandwidth for 802.11a (15.407)

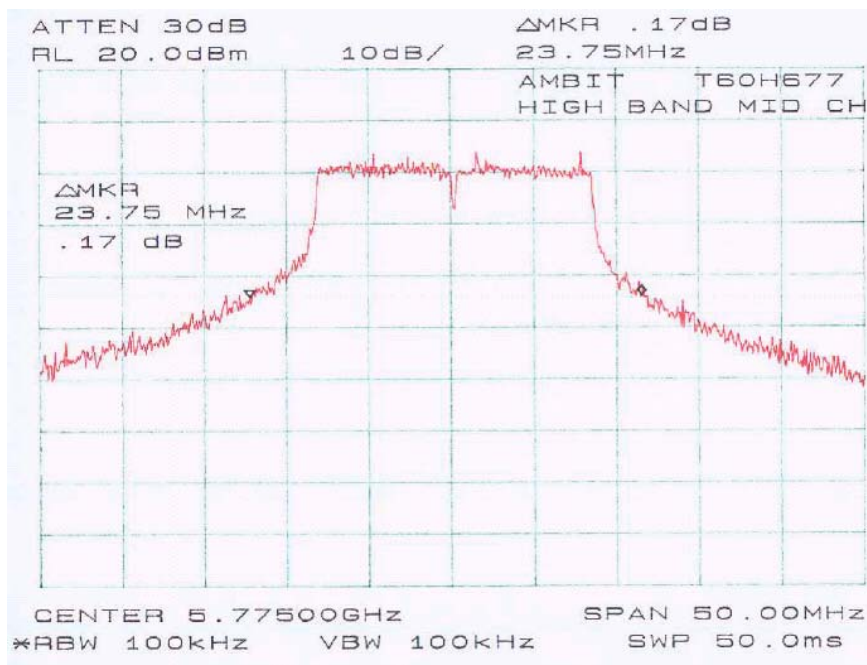
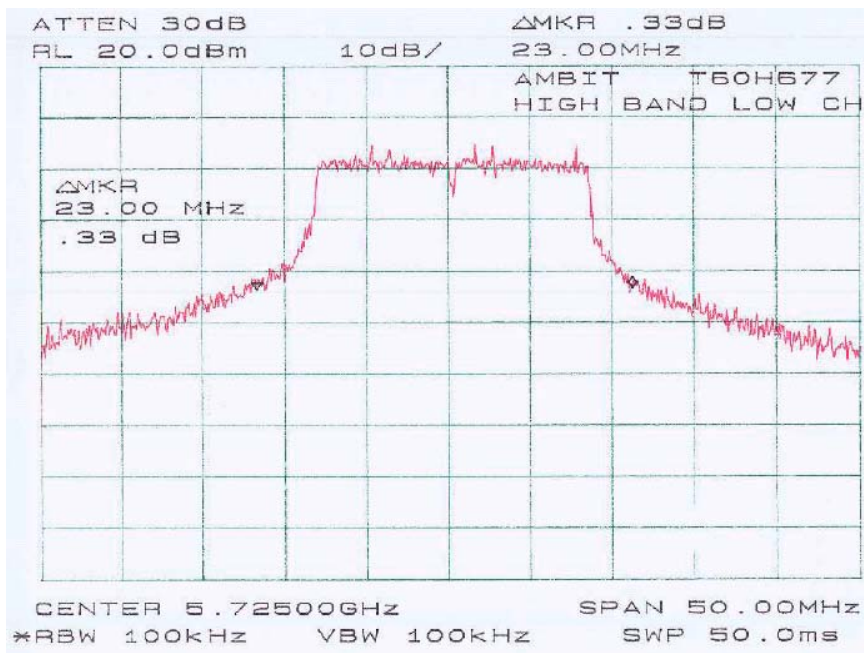


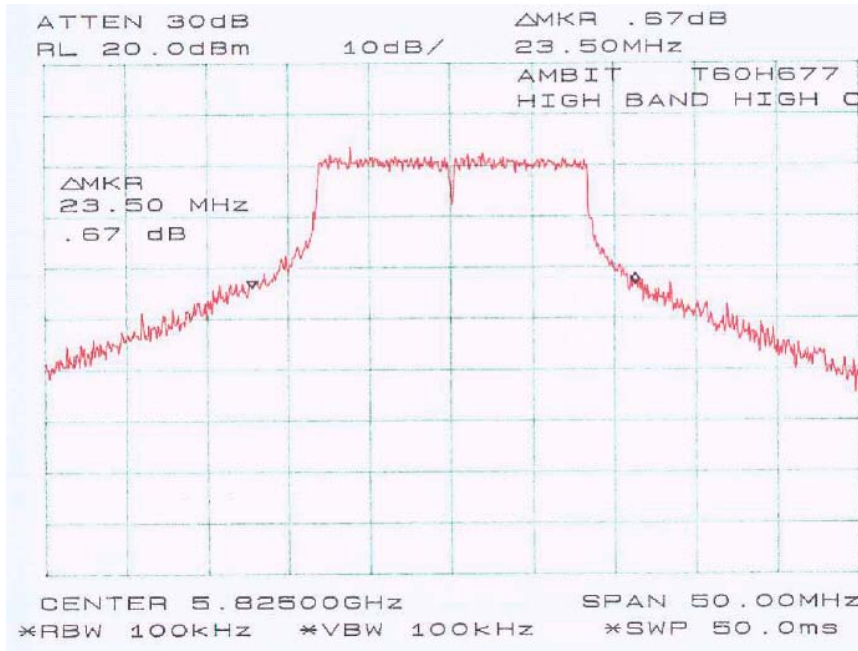












**§15.247(b)(3), §15.407(a)(2) - PEAK OUTPUT POWER MEASUREMENT**

**Standard Applicable**

According to §15.247(b) (3), for systems using digital modulation in 2400-2483.5 MHz: 1 Watt

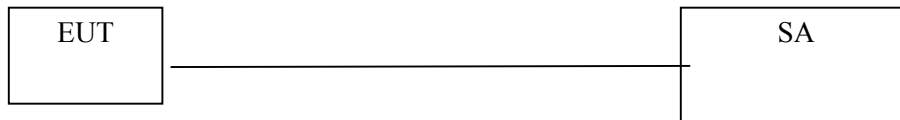
According to §15.407(a)(1), for the band 5.15-5.25 GHz, the peak transmit power over the frequency band of operation shall not exceed the lesser of 50 mW or 4 dBm + 10logB, where B is the 26-dB emission bandwidth in MHz.

According to §15.407(a)(2), for the band 5.25-5.35 GHz, the peak transmit power over the frequency band of operation shall not exceed the lesser of 250 mW or 11 dBm + 10logB, where B is the 26-dB emission bandwidth in MHz.

According to §15.407(a)(3), for the band 5.725-5.825 GHz, the peak transmit power over the frequency band of operation shall not exceed the lesser of 1 W or 17 dBm + 10logB, where B is the 26-dB emission bandwidth in MHz.

**Measurement Procedure**

1. Place the EUT on a bench and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to a spectrum analyzer.
3. Add a correction factor to the display.



**Equipment Lists**

Manufacturer	Model No.	Description	Calibration Date
HP	8565EC	Spectrum Analyzer	2003-01-22

**Measurement Result**

**Environmental Conditions**

Temperature:	12° C
Relative Humidity:	48%
ATM Pressure:	1100 mbar

**RF Output Power (15.247) for 802.11b**

Port	Channel	Frequency (MHz)	Output Power (dBm)	Correction Factor (dB)	Corrected Output Power (dBm)	Output Power (W)	Standard (W)	Result
J1	Low	2412	9.5	7.2	16.70	0.0468	≤ 1W	Compliant
	Mid	2437	9.17	7.2	16.37	0.0434	≤ 1W	Compliant
	High	2462	8.67	7.2	15.87	0.0386	≤ 1W	Compliant

Note: Correction Factor = 10Log(BW6dB/RBW) = 10Log(10.5/2) = 7.2dB

**RF Output Power (15.247) for 802.11g**

	Channel	Frequency (MHz)	Peak Output Power (dBm)	Correction Factor (dBm)	Corrected Factor (dBm)	Output Power (W)	Standard (W)	Result
J1 Port	Low	2412	6.33	9.3	15.63	0.037	≤ 1 W	Compliant
	Mid	2442	6.50	9.3	15.80	0.038	≤ 1 W	Compliant
	High	2462	6.67	9.3	15.97	0.040	≤ 1 W	Compliant

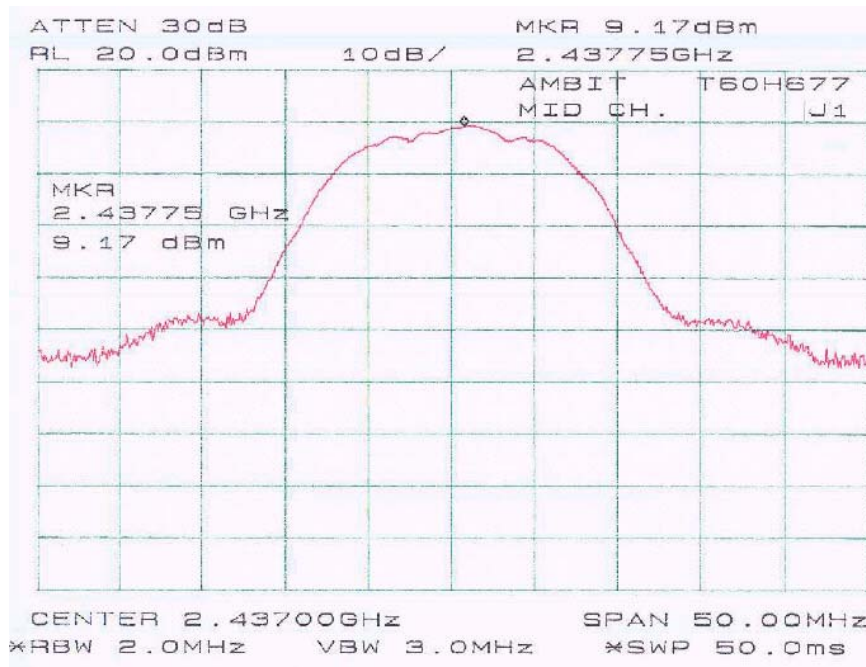
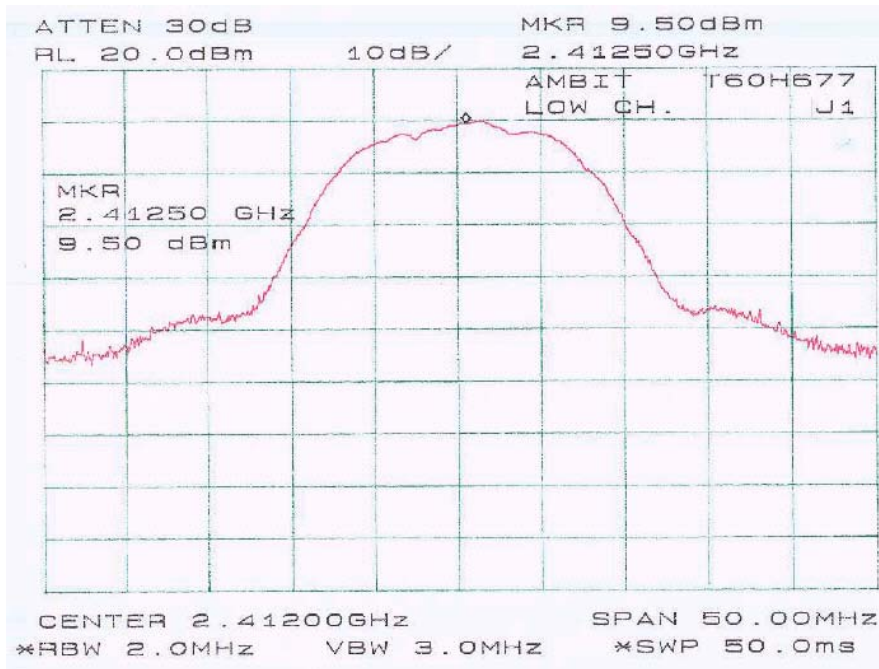
Note: Correction Factor = 10 log (BW6dB/RBW) = 10 log (17/2.0) = 9.3 dBm

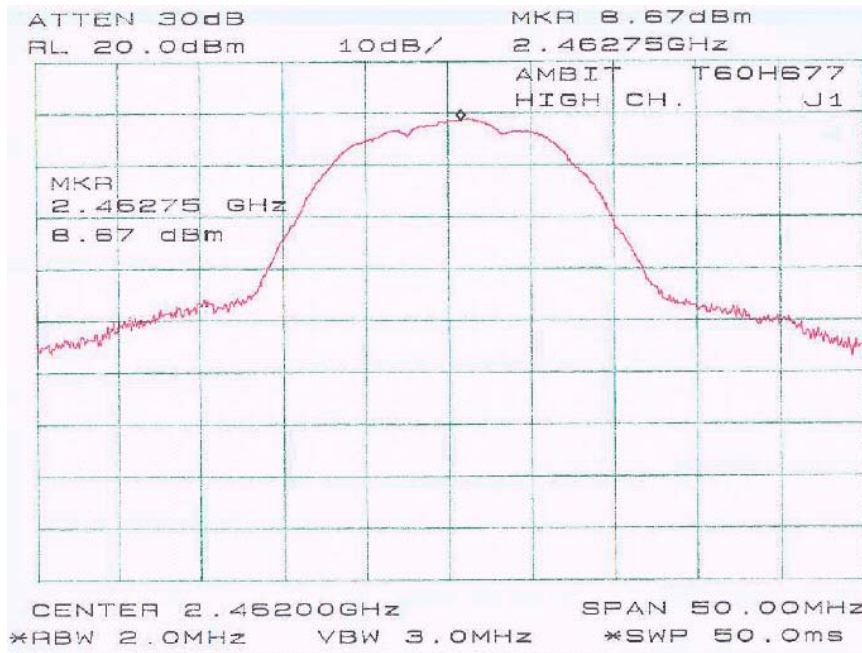
**RF Output Power (15.407) for 802.11a**

Band	Channel (MHz)	Frequency (MHz)	Output Power (dBm)	Correction Factor (dB)	Corrected Output Power (dBm)	Output Power (W)	Standard (mW)	Result
Low	Low	5150	5.83	10.7	16.53	0.0449	<50	Compliant
	Mid	5200	6	10.7	16.7	0.0468	<50	Compliant
	High	5250	5.5	10.7	16.2	0.0417	<50	Compliant
Mid	Low	5250	5.5	10.7	16.2	0.0417	<50	Compliant
	Mid	5300	5.33	10.7	16.03	0.0401	<50	Compliant
	High	5330	5.83	10.7	16.53	0.0449	<50	Compliant
High	Low	5745	5.33	10.7	16.03	0.0401	<50	Compliant
	Mid	5775	5.67	10.7	16.37	0.0434	<50	Compliant
	High	5810	5.83	10.7	16.53	0.0449	<50	Compliant

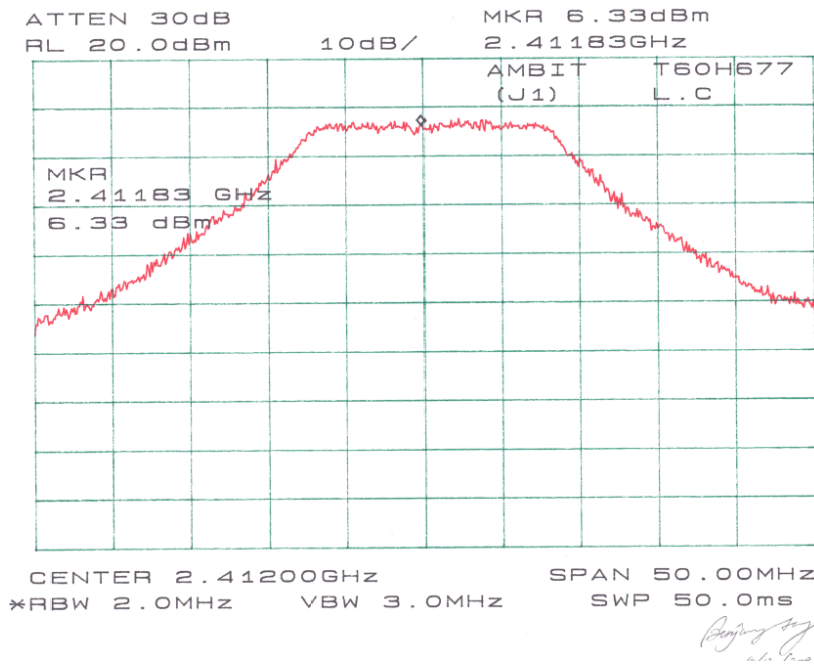
Note: Correction Factor = 10Log(BW26dB/RBW) = 10Log(23.83/2) = 10.7dB  
 Test mode: target power = 15.0, ext pw detector = 1, xpdgain = 6, ob = 1, db = 2, b-ob = 1

Plots of Peak Output Power for 802.11b (15.247)

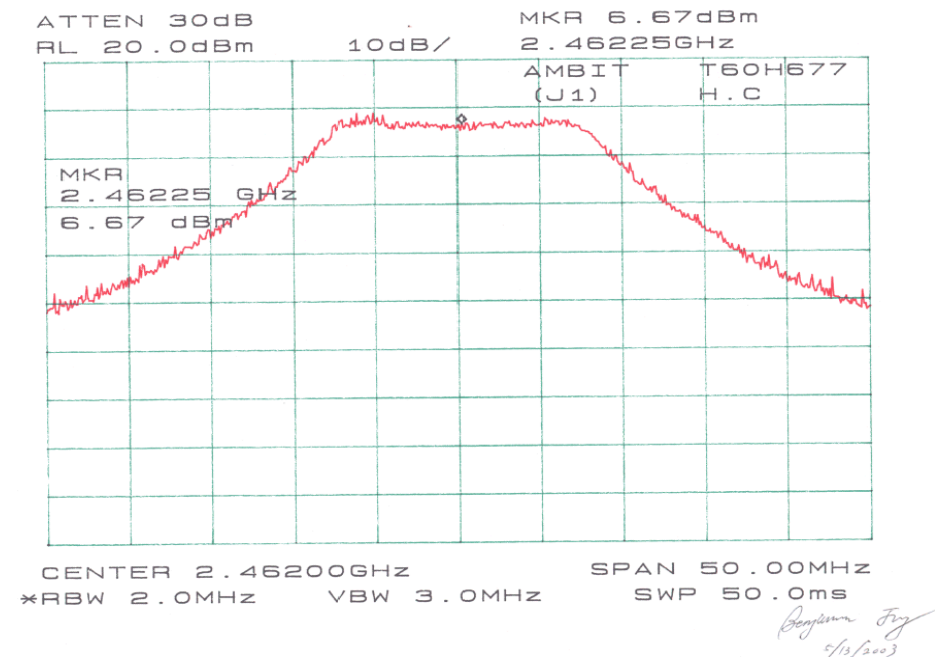
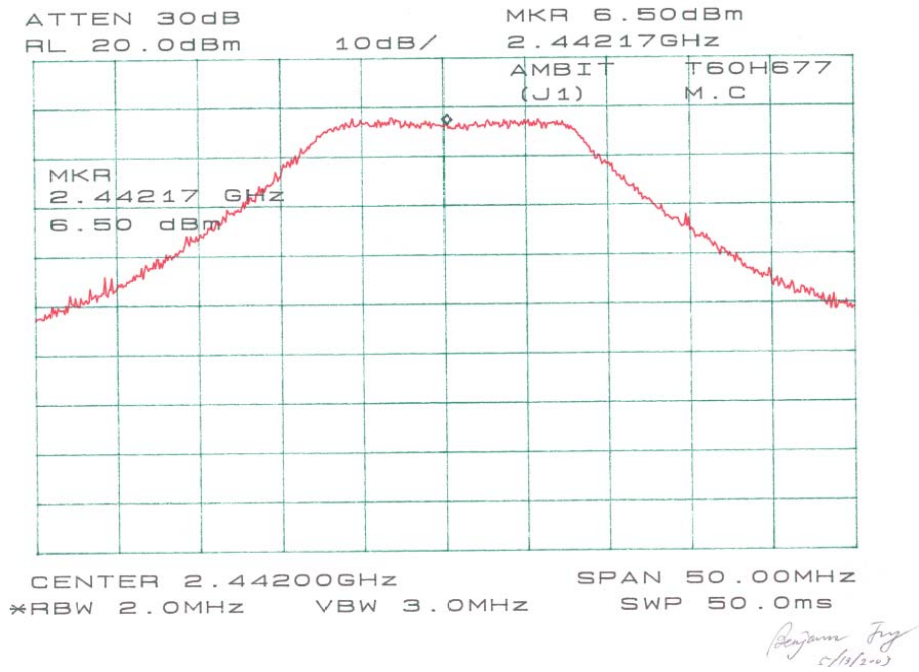




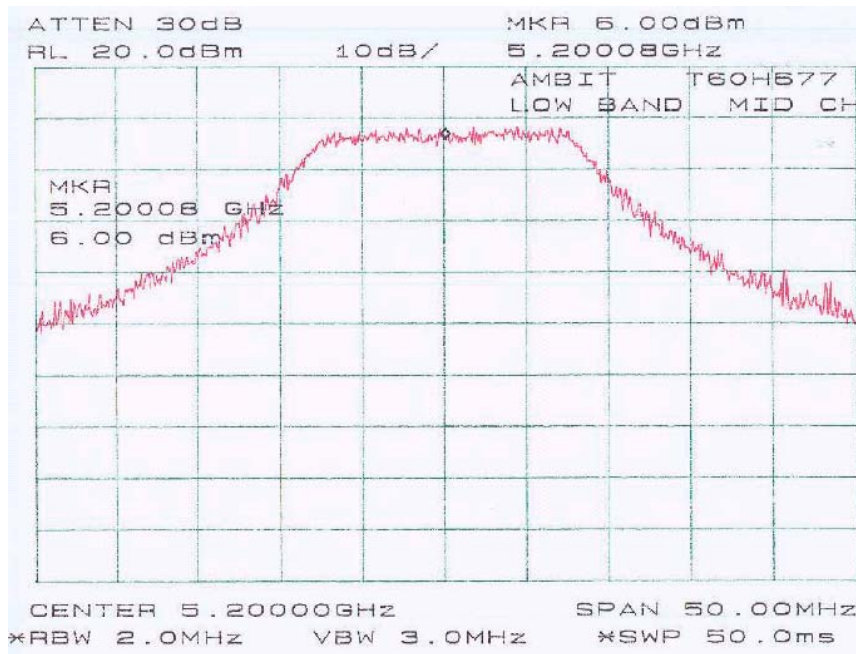
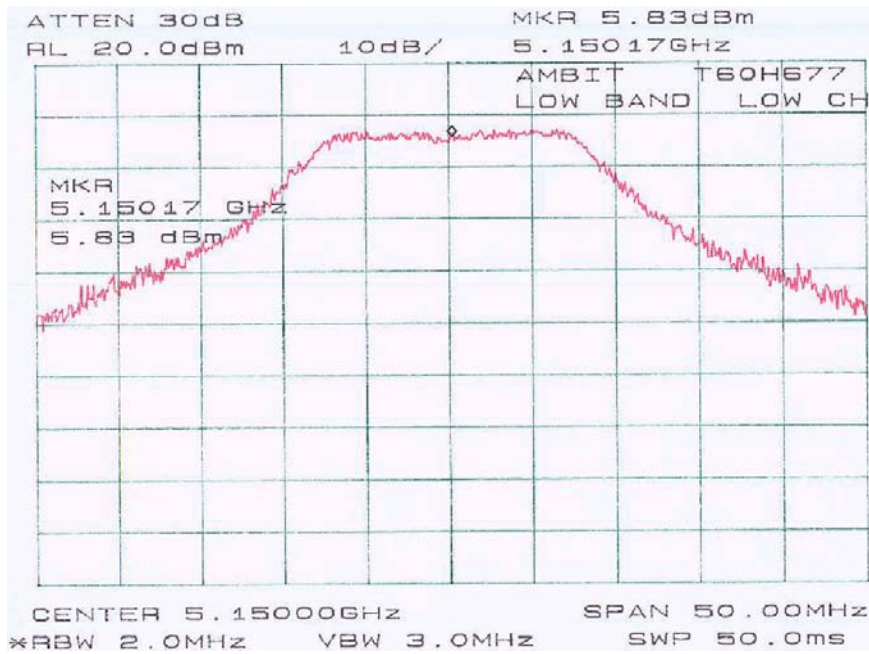
Plots of Peak Output Power for 802.11 g (15.247)

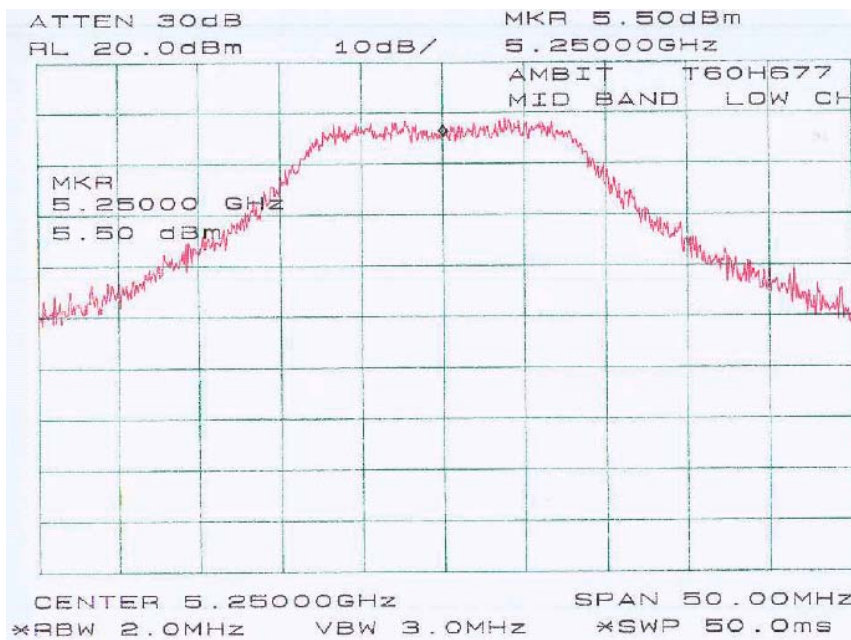
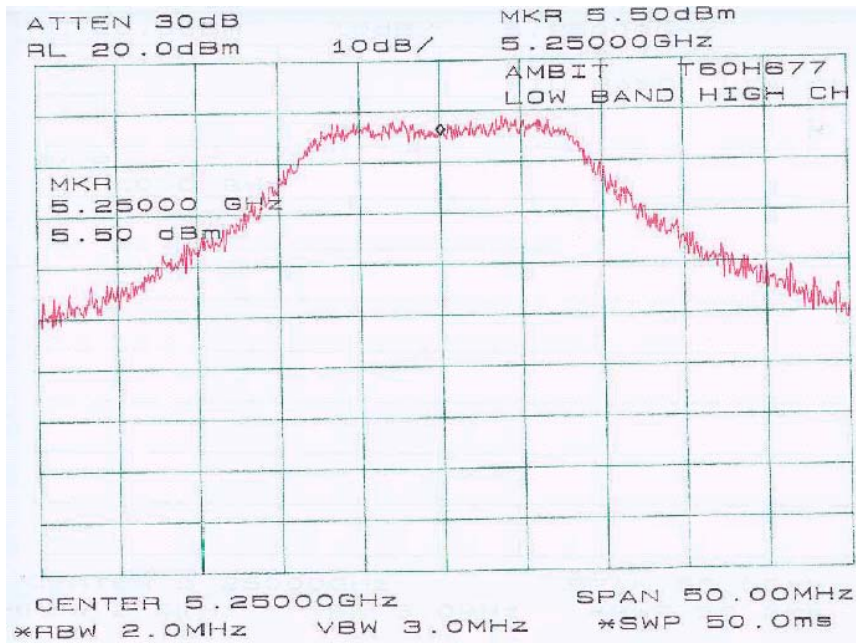


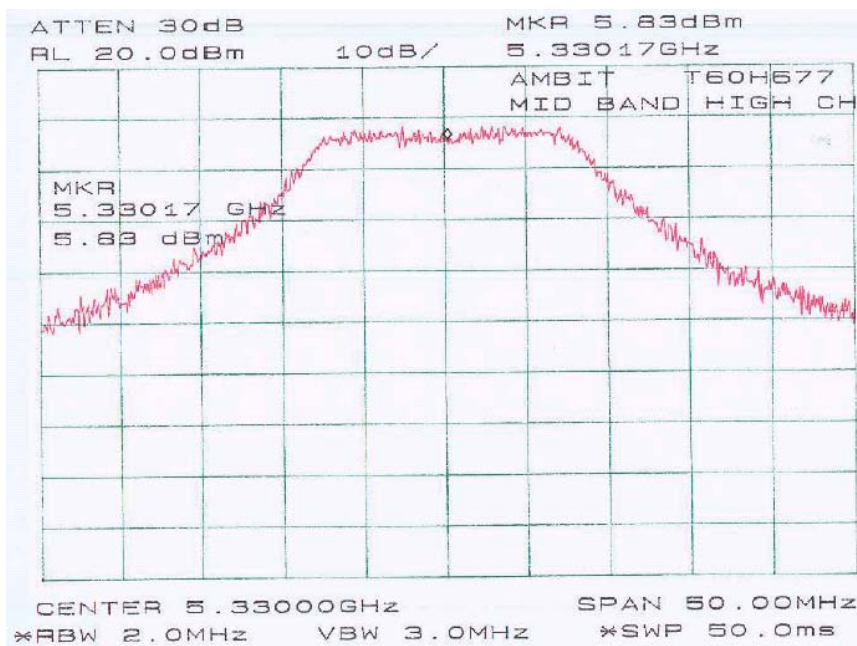
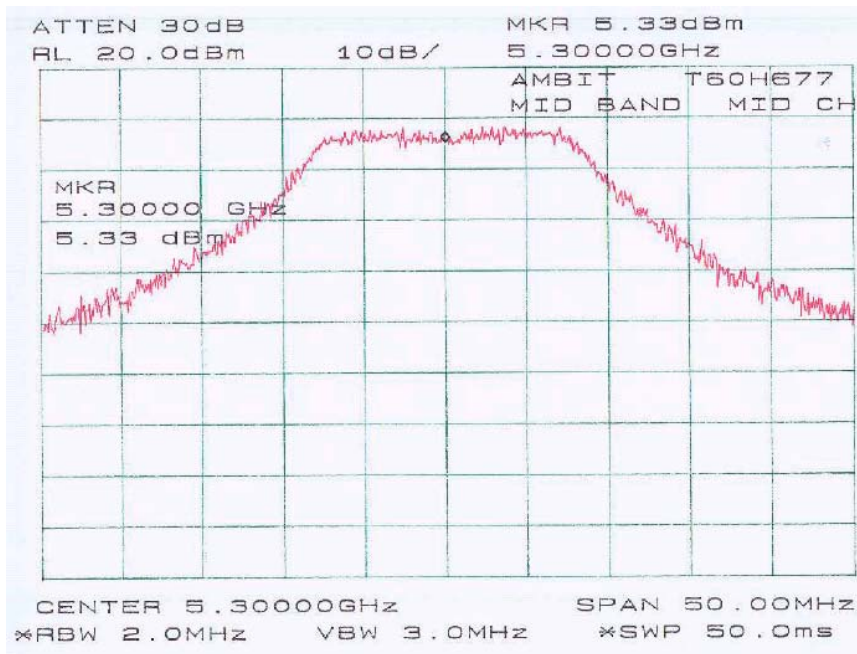




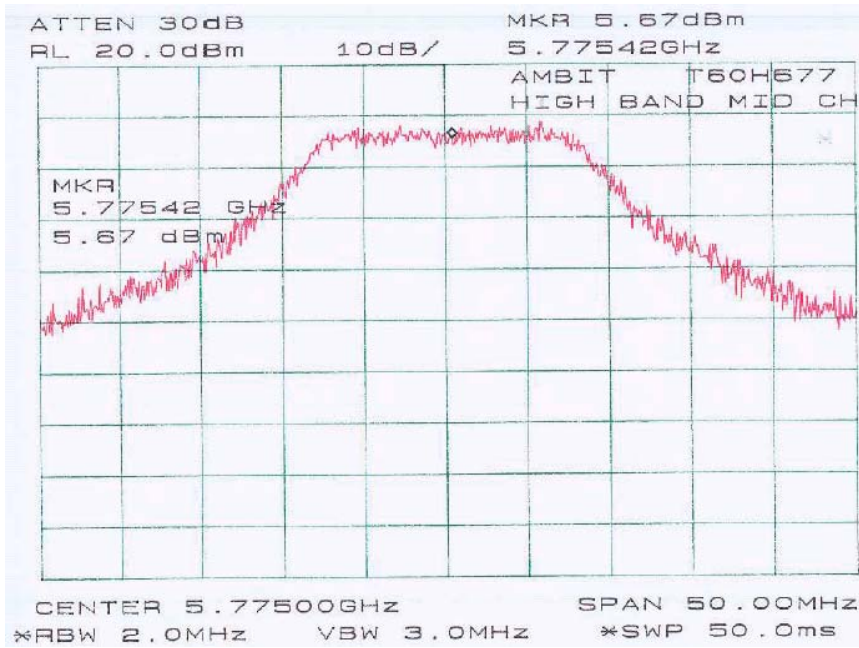
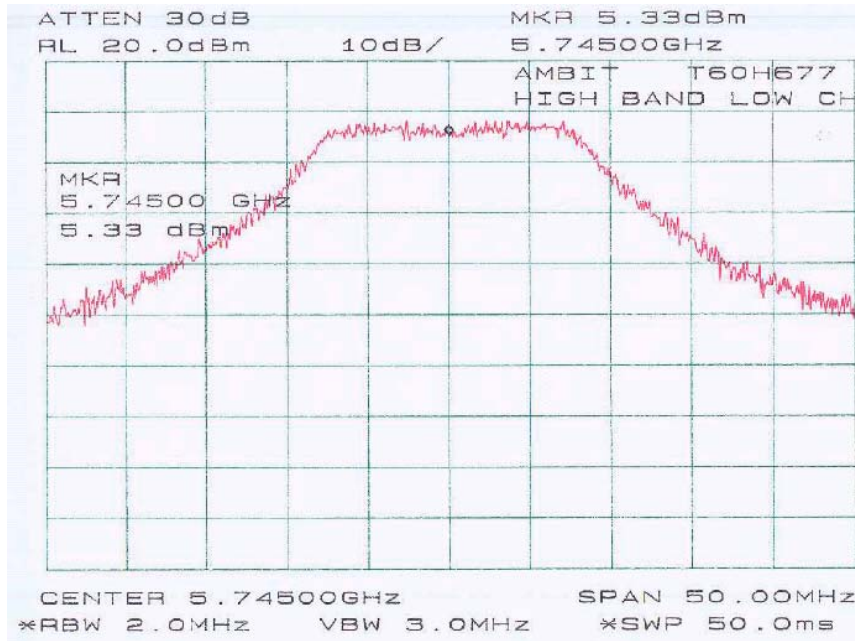
Plots of Peak Output Power for 802.11a (15.407)

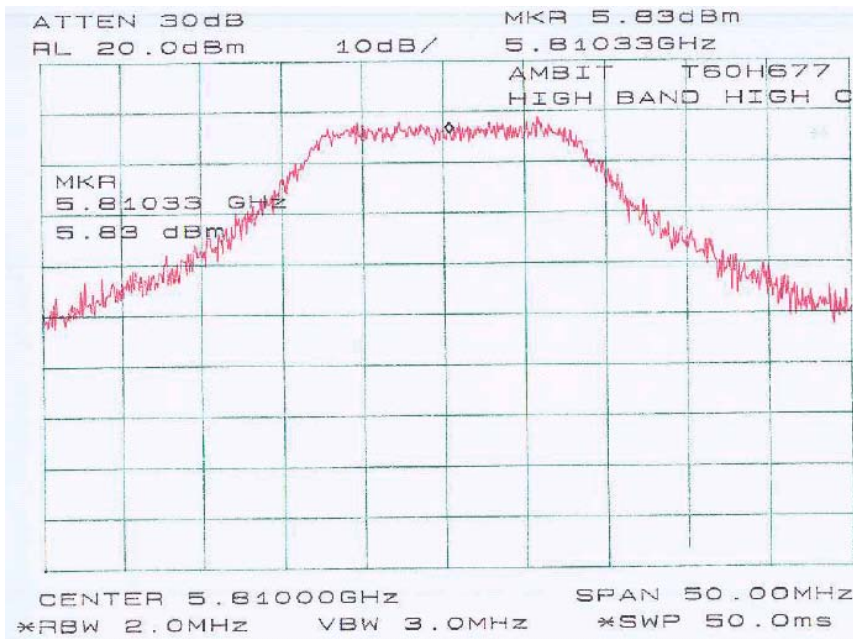














## §15.247(c) - 100 KHZ BANDWIDTH OF BAND EDGES

### Standard Applicable

According to §15.247(c), in *any* 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) see §15.205(c).

### Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set both RBW and VBW of spectrum analyzer to 100 kHz with a convenient frequency span including 100kHz bandwidth from band edge.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

### Equipment Lists

Manufacturer	Model No.	Description	Calibration Date
Agilent	8564E	Spectrum Analyzer	2003-08-26

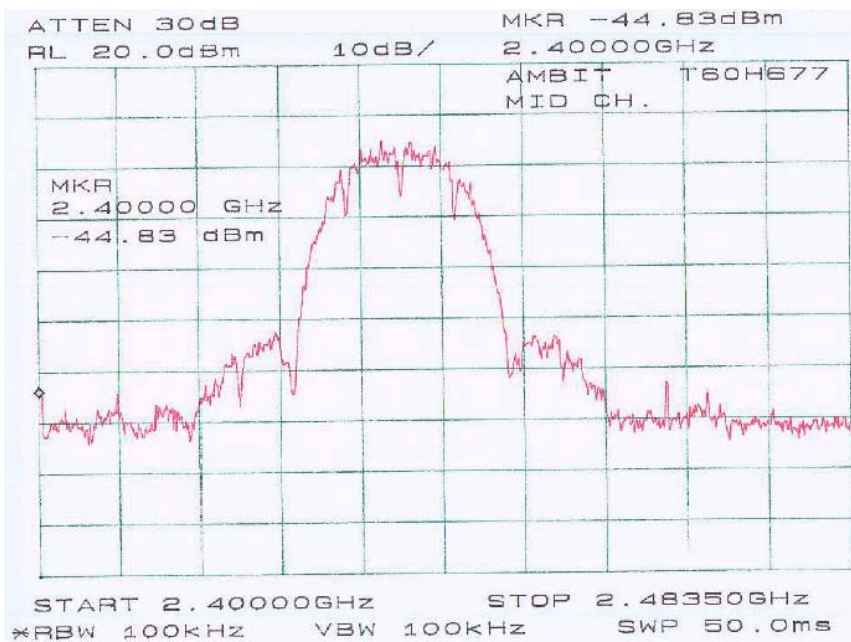
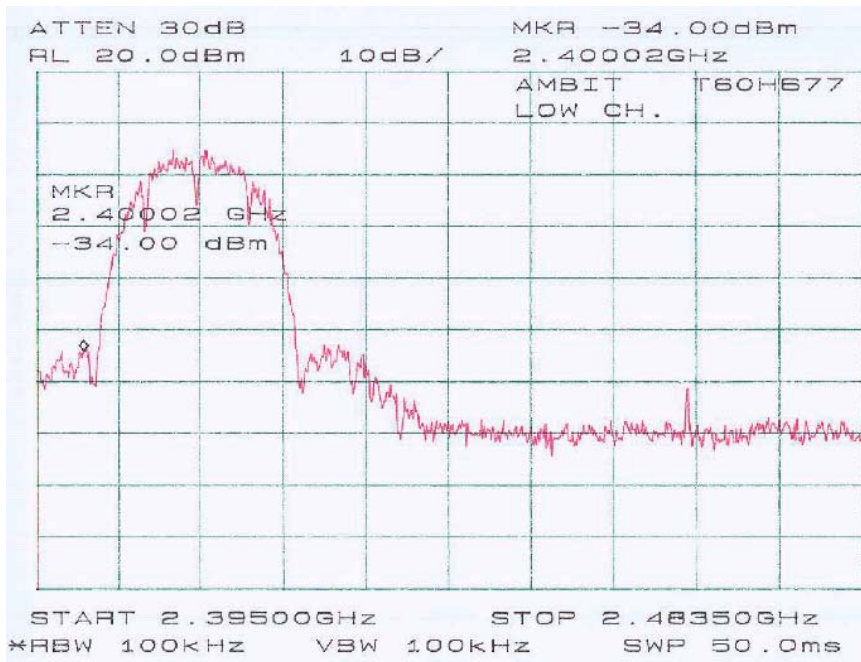
### Measure Results

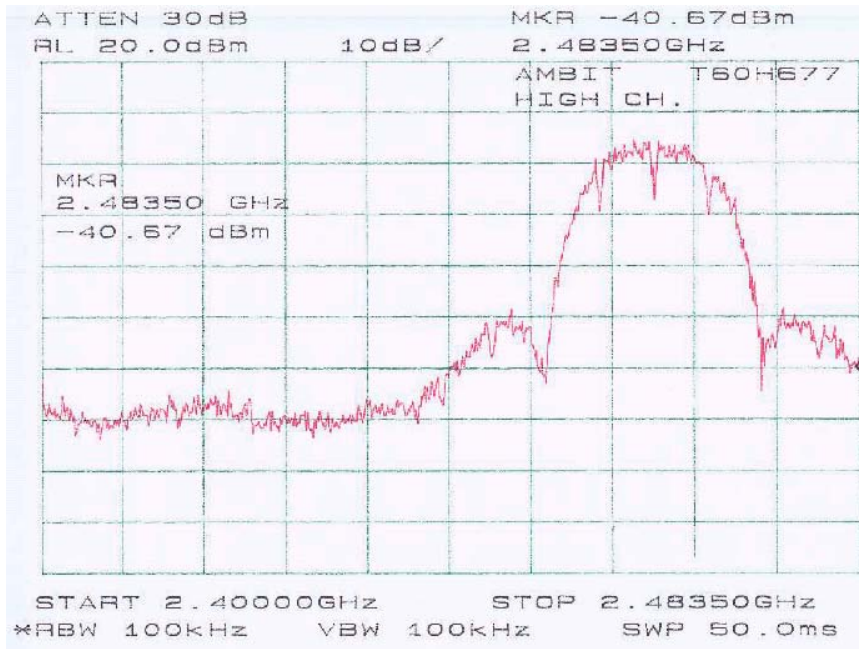
#### Environmental Conditions

Temperature:	12° C
Relative Humidity:	48%
ATM Pressure:	1100 mbar

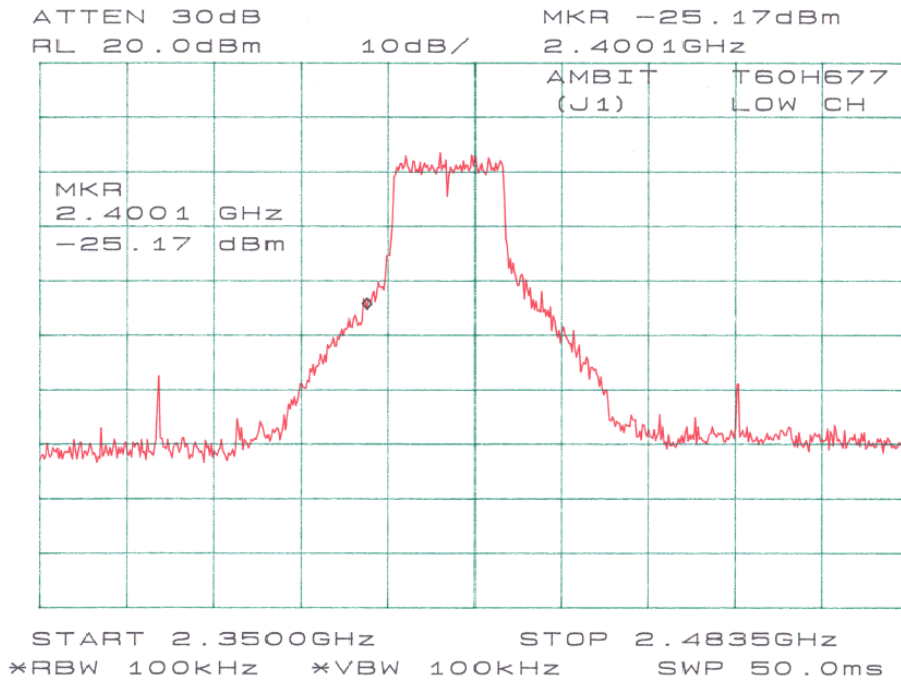
Please refer to following pages for plots of band edge.

Plots of Band Edge for 802.11b (15.247)

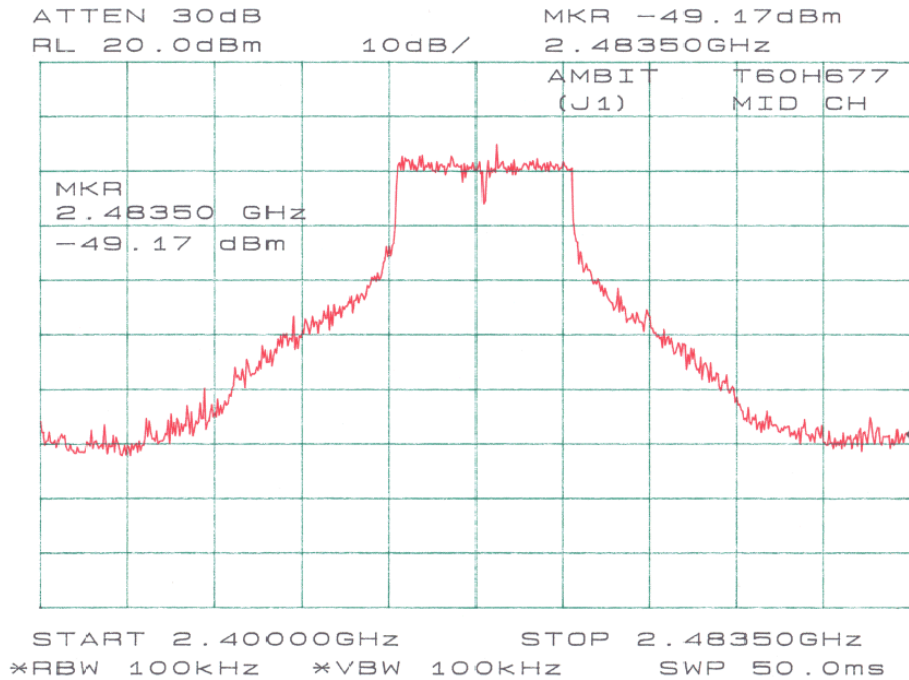




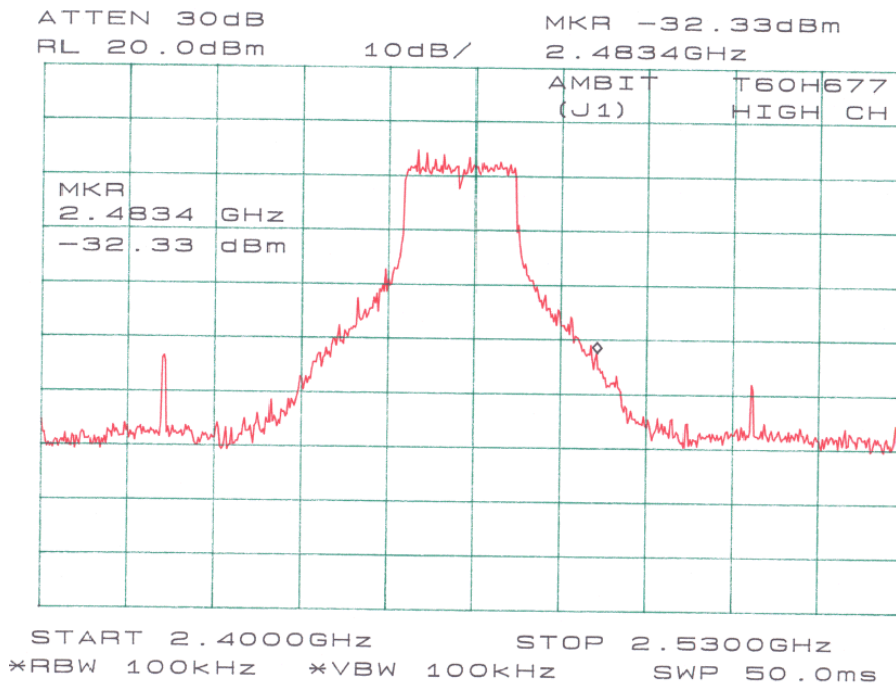
Plots of Band Edge for 802.11g (15.247)



*Boyan Jey 5/1/03*



*Byron Fry 5/13/2013*



*Byron Fry 5/13/2013*

## **§15.247(d) & §15.407(a)(2) - POWER SPECTRAL DENSITY**

### **Standard Applicable**

According to §15.247 (d), for direct sequence systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

According to §15.407(a) (1), for the band 5.15-5.25 GHz, the peak power spectral density shall not exceed 4 dBm in any 1-MHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the peak transmit power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

According to §15.407(a) (2), for the band 5.25-5.35 GHz, the peak power spectral density shall not exceed 11 dBm in any 1-MHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the peak transmit power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceed 6 dBi.

According to §15.407(a) (3), for the band 5.725-5.825 GHz, the peak power spectral density shall not exceed 17 dBm in any 1-MHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the peak transmit power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

### **Measurement Procedure**

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT was set without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Adjust the center frequency of SA on any frequency be measured and set SA to 6MHz span mode. And then, set RBW and VBW of spectrum analyzer to proper value. (DTS)
4. Adjust the center frequency of SA on any frequency be measured and set SA to 50MHz span mode. And then, set RBW and VBW of spectrum analyzer to proper value. (UNII)
5. Repeat above procedures until all frequencies measured were complete.

### **Equipment Lists**

Manufacturer	Model No.	Description	Calibration Date
Agilent	8564E	Spectrum Analyzer	2003-08-26

**Measurement Results**

**Environmental Conditions**

Temperature:	12° C
Relative Humidity:	48%
ATM Pressure:	1100 mbar

**Test Result for 802.11b (15.247)**

Channel	Frequency (MHz)	Peak Power Spectral Density (dBm)	Standard (dBm)	Result
Low	2412	-10.67	≤ 8	Compliant
Mid	2437	-10.33	≤ 8	Compliant
High	2462	-12.00	≤ 8	Compliant

**Test Result for 802.11b (15.247)**

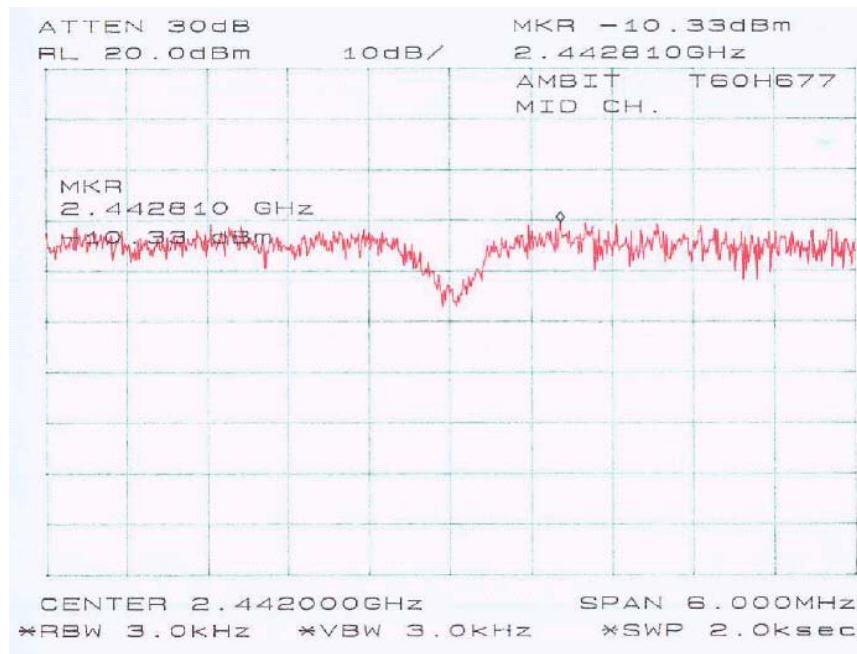
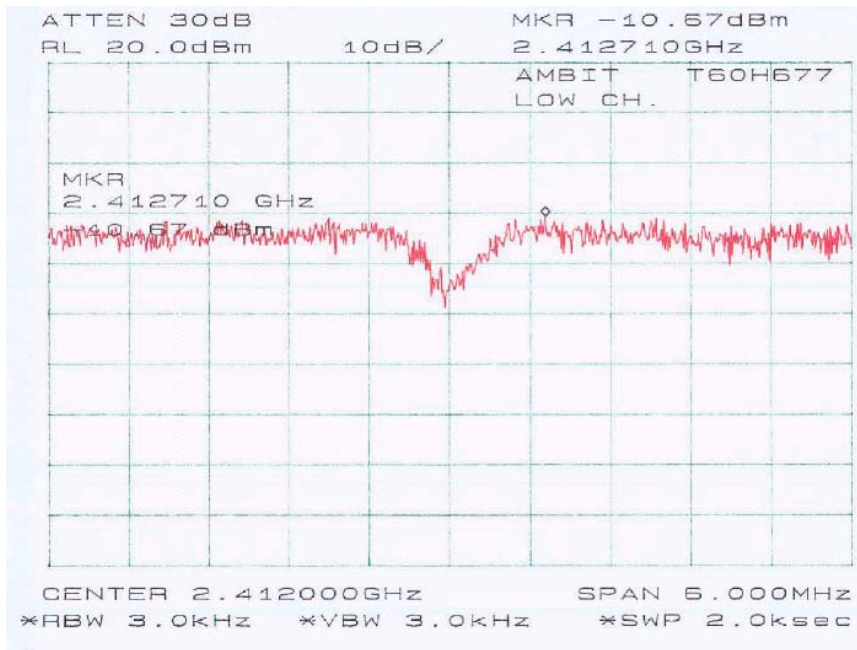
	Frequency (MHz)	Peak Power Spectral Density	Standard (dBm)	Result
J1 Port	2412	-6.17	≤ 8	Compliant
	2442	-8.67	≤ 8	Compliant
	2462	-9.17	≤ 8	Compliant

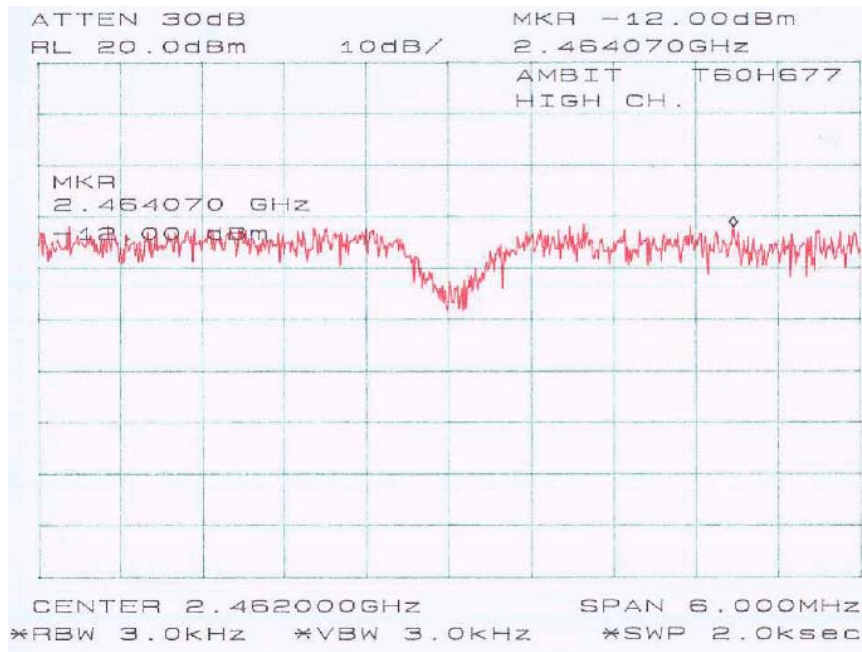
**Test Result for 802.11a (15.407)**

Band	Channel	Frequency (MHz)	Peak Power Spectral Density (dBm)	Standard (dBm)	Result
Low	Low	5150	-8.83	≤ 4	Compliant
	Mid	5200	-10.17	≤ 4	Compliant
	High	5250	-9.50	≤ 4	Compliant
Mid	Low	5250	-8.83	≤ 11	Compliant
	Mid	5300	-9.67	≤ 11	Compliant
	High	5330	-7.50	≤ 11	Compliant
High	Low	5745	-8.17	≤ 17	Compliant
	Mid	5775	-9.83	≤ 17	Compliant
	High	5810	-10.00	≤ 17	Compliant

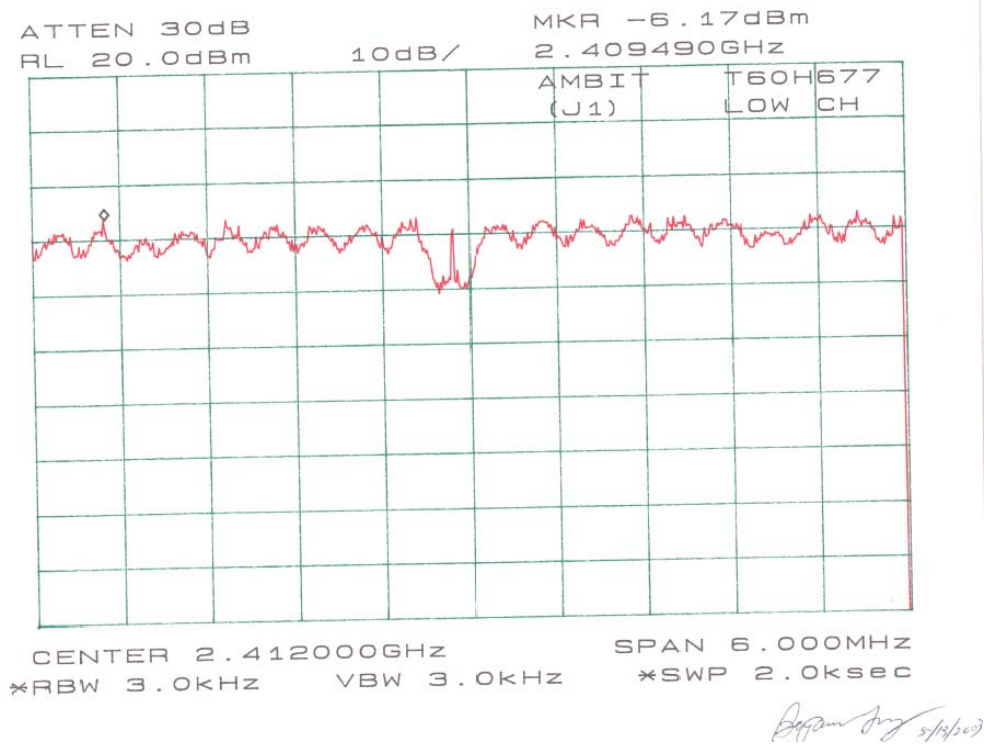


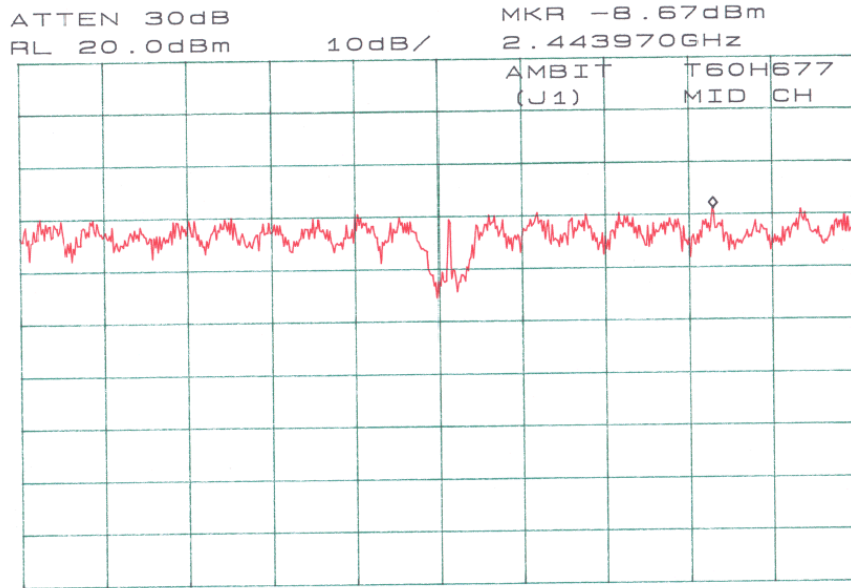
Plots of Power Spectral Density for 802.11b (15.247)





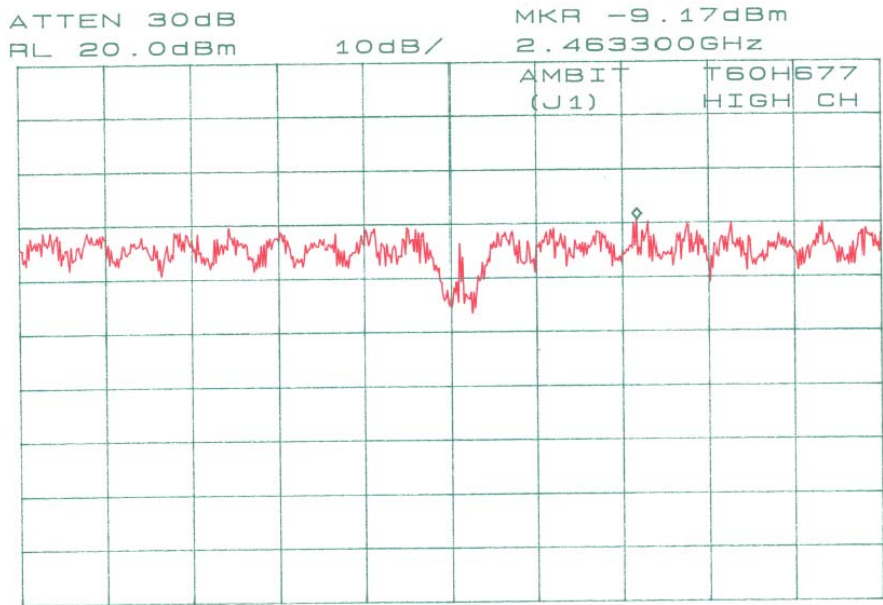
Plots of Power Spectral Density for 802.11g (15.247)





CENTER 2.442000GHz SPAN 6.000MHz  
\*RBW 3.0kHz VBW 3.0kHz \*SWP 2.0ksec

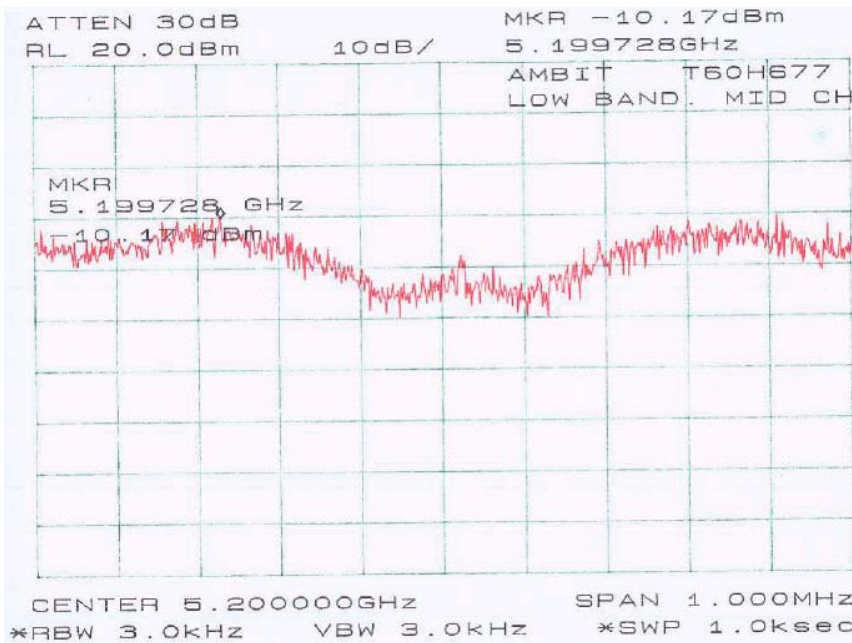
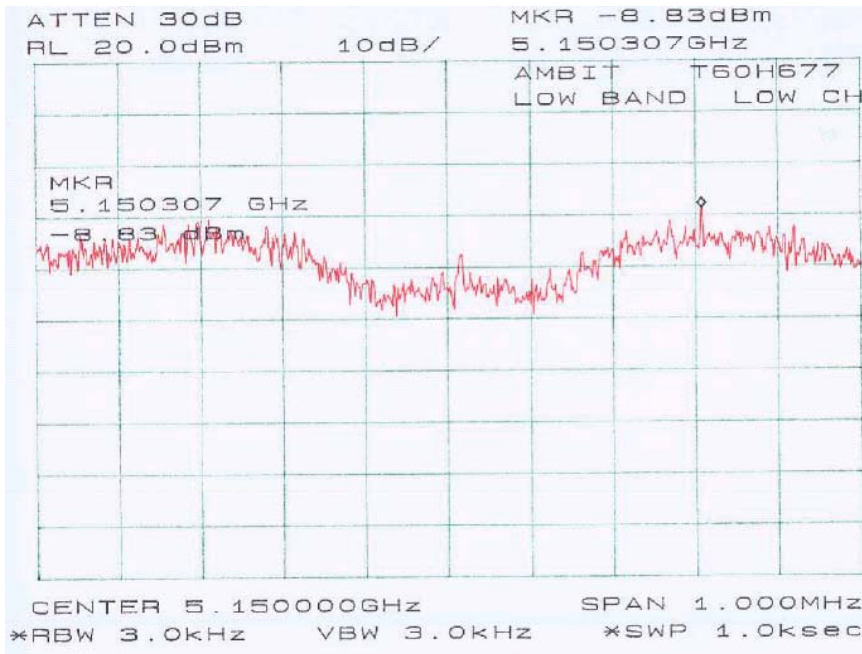
*Byron Fry 5/13/03*



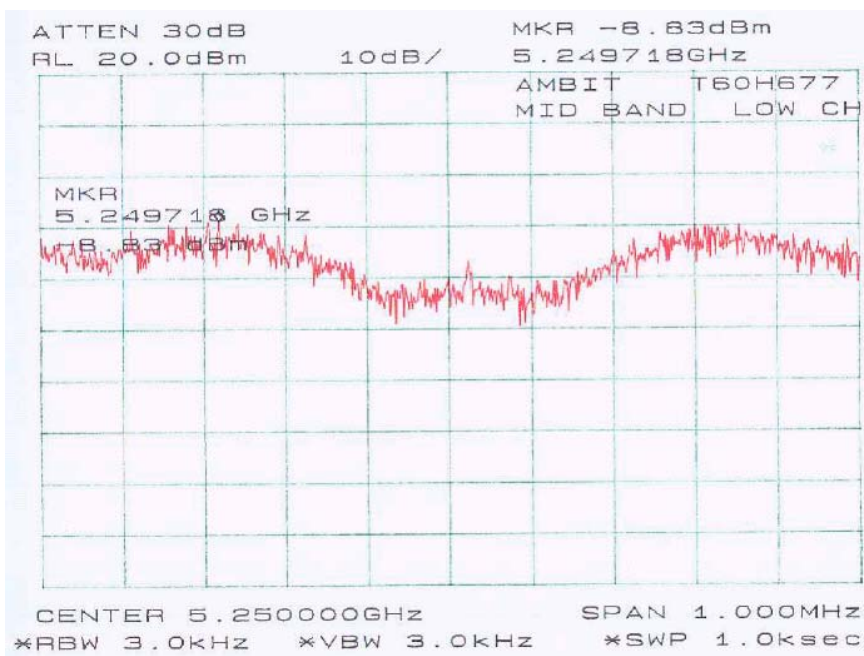
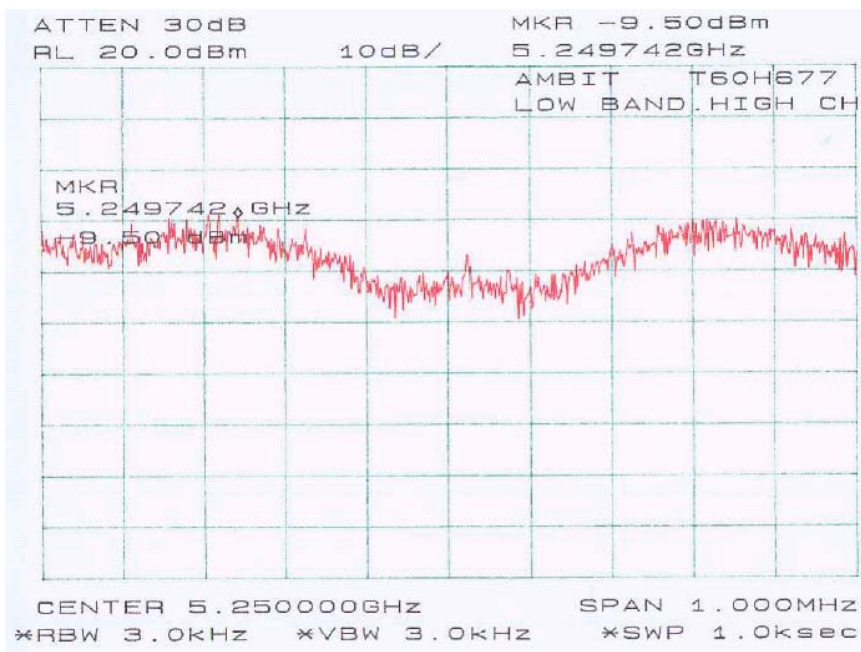
CENTER 2.462000GHz SPAN 6.000MHz  
\*RBW 3.0kHz VBW 3.0kHz \*SWP 2.0ksec

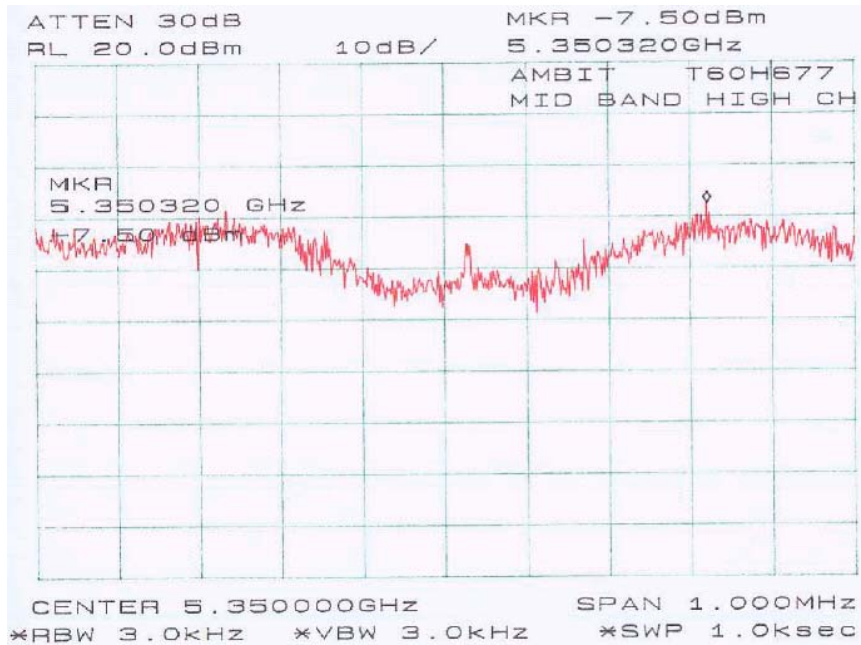
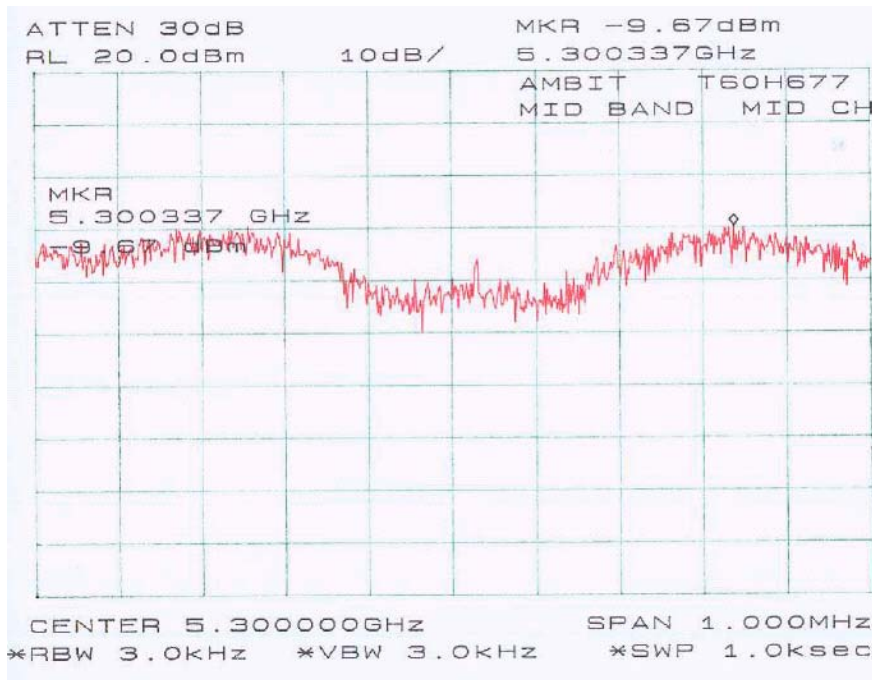
*Byron Fry 5/13/03*

Plots of Spectral Density for 802.11a (15.407)

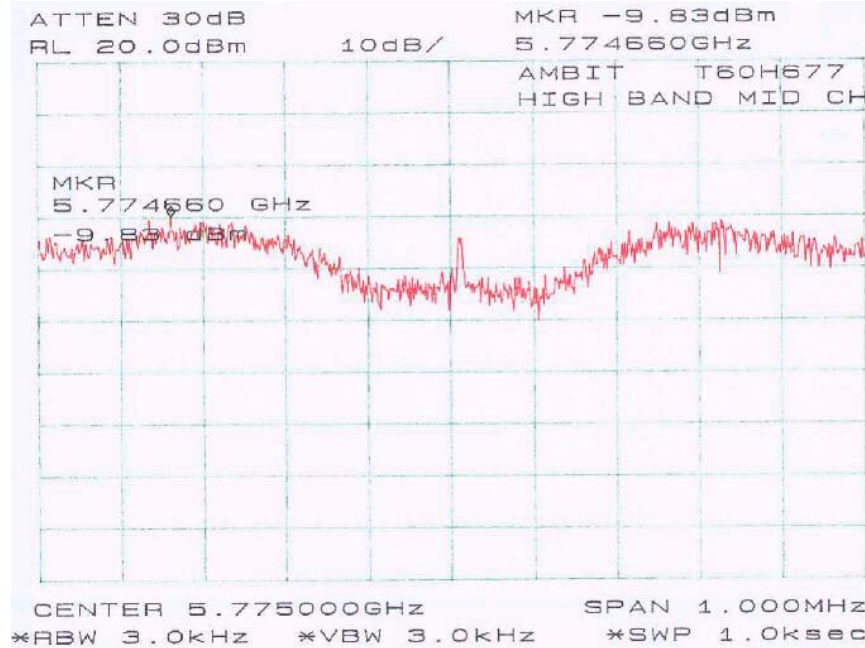
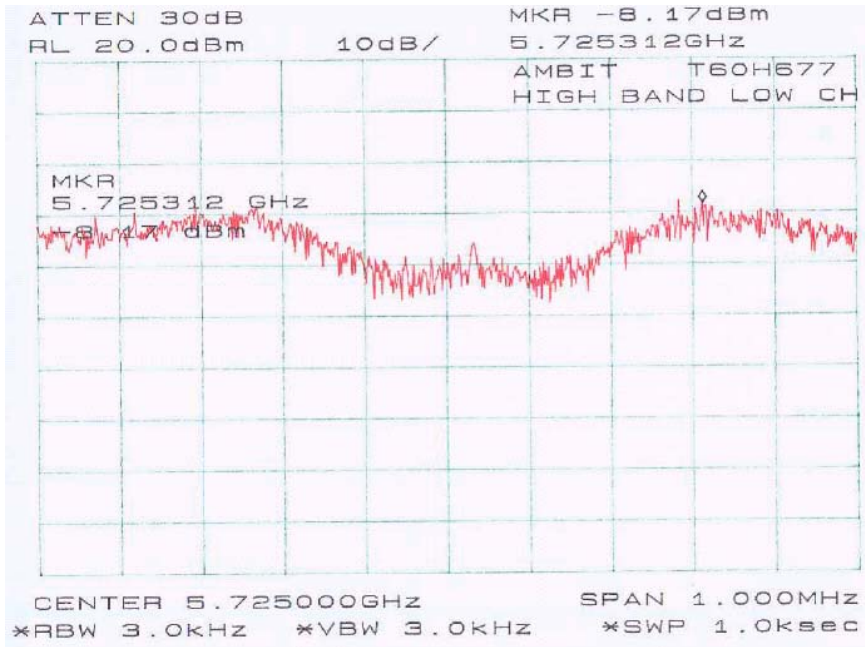


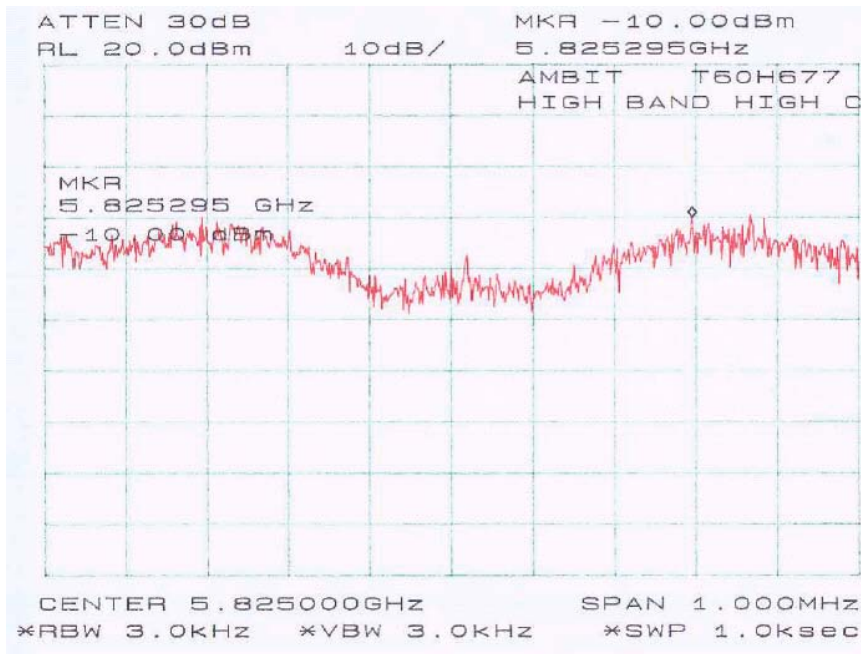












## §15.407(a)(6) - Peak Excursion To Average Ratio

### Standard Applicable

According to §15.407(a)(6), the ratio of the peak excursion of the modulation envelope (measured using a peak hold function) to the peak transmit power (measured as specified above) shall not exceed 13dB across any 1MHz bandwidth or the emission bandwidth whichever is less.

### Test Procedure

For this test, the EUT’s antenna was removed and replaced with a SMA jack to UMP2.0 plug test cable, so output power levels were calculated from conducted emission levels.

The analyzer center frequency was set to the EUT carrier frequency. For the peak value trace A, the analyzer resolution and video bandwidth were set to 1MHz. Do a MAX HOLD, then VIEW. For the average value trace B, the analyzer resolution bandwidth was set to 1MHz, the video bandwidth was set to 30kHz. MAX HOLD then VIEW trace B also.

The delta from the peak value trace and the Average should not exceed 13dBm across any 1MHz bandwidth.

### Equipment Lists

Manufacturer	Model No.	Description	Calibration Date
Agilent	8564E	Spectrum Analyzer	2003-08-26

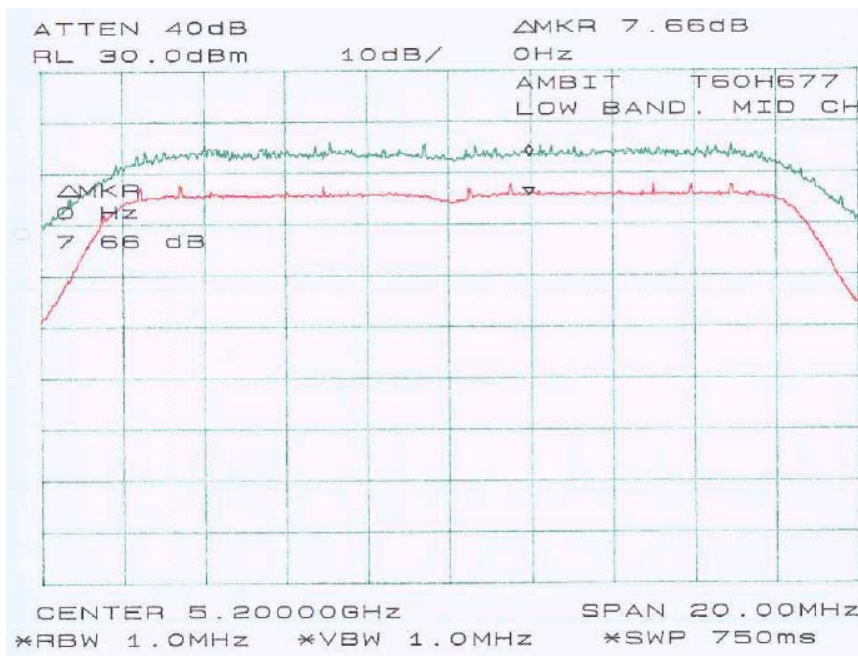
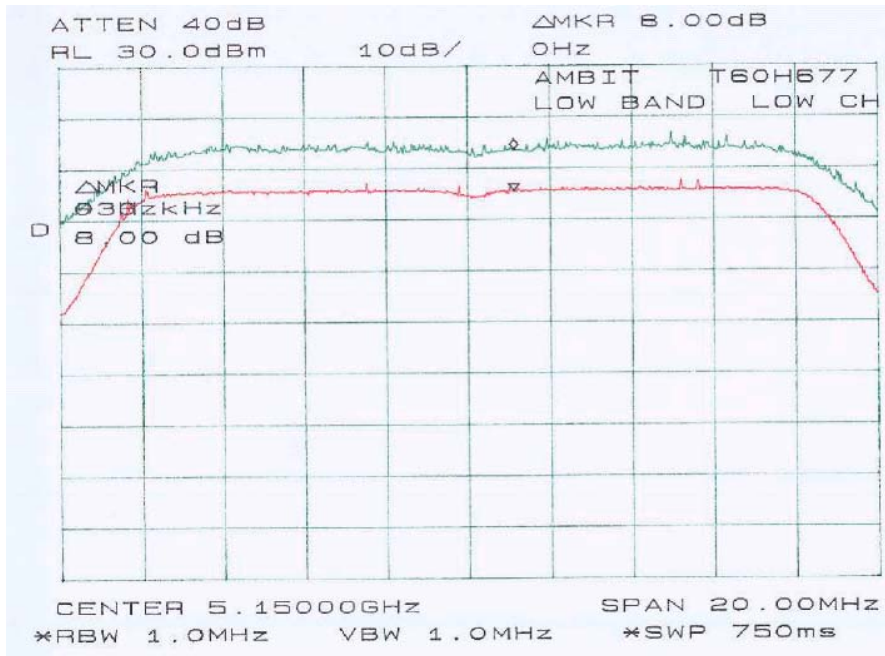
### Test Result for

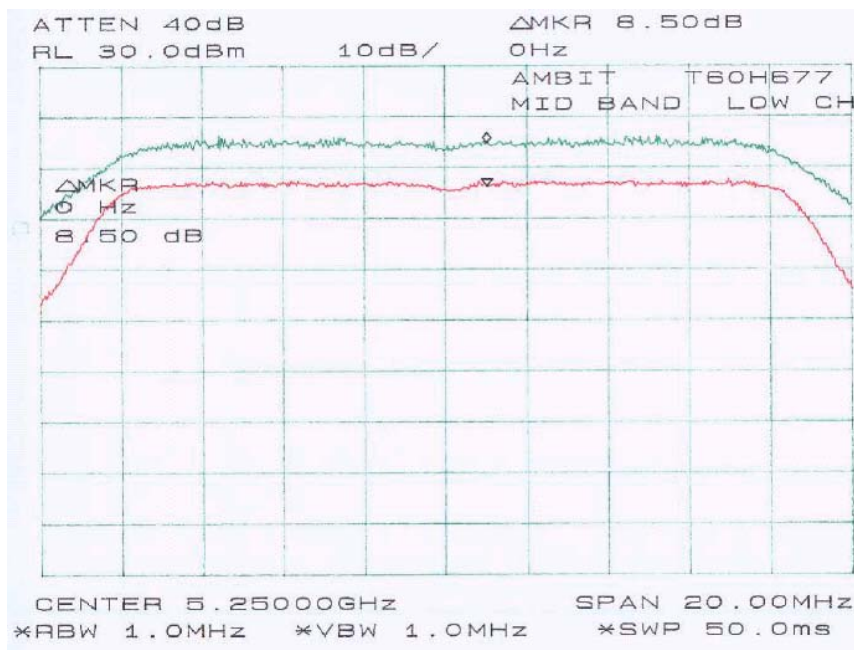
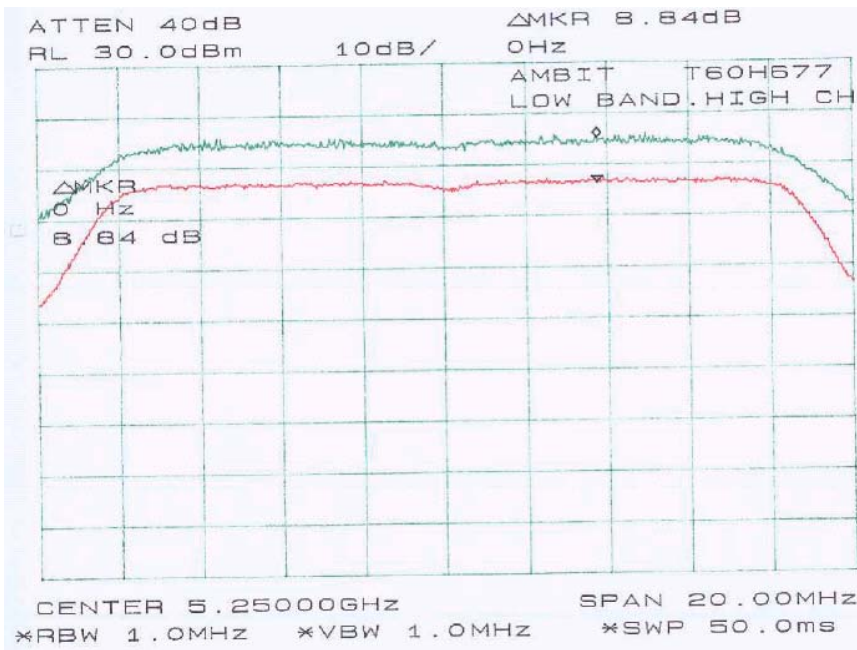
#### Environmental Conditions

Temperature:	12° C
Relative Humidity:	48%
ATM Pressure:	1100 mbar

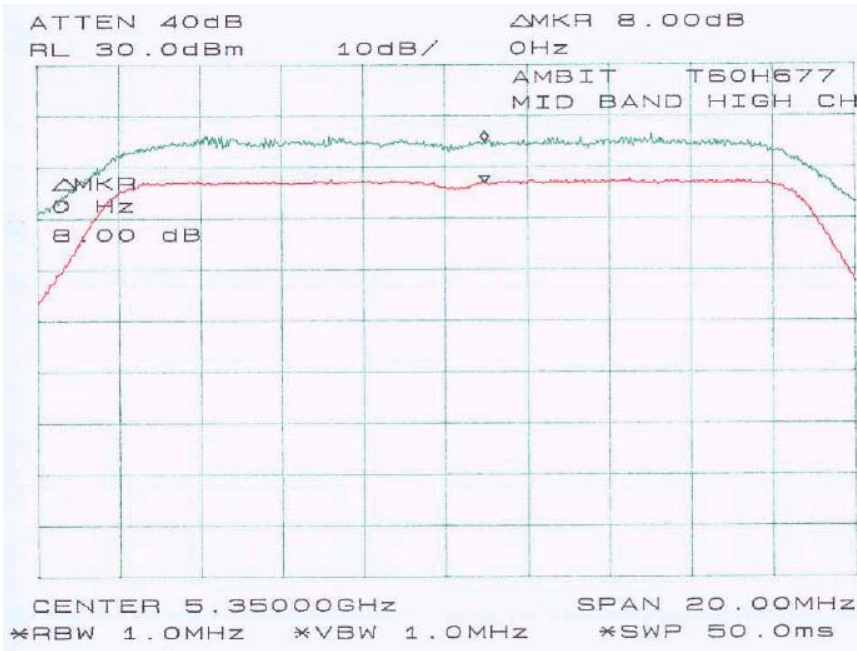
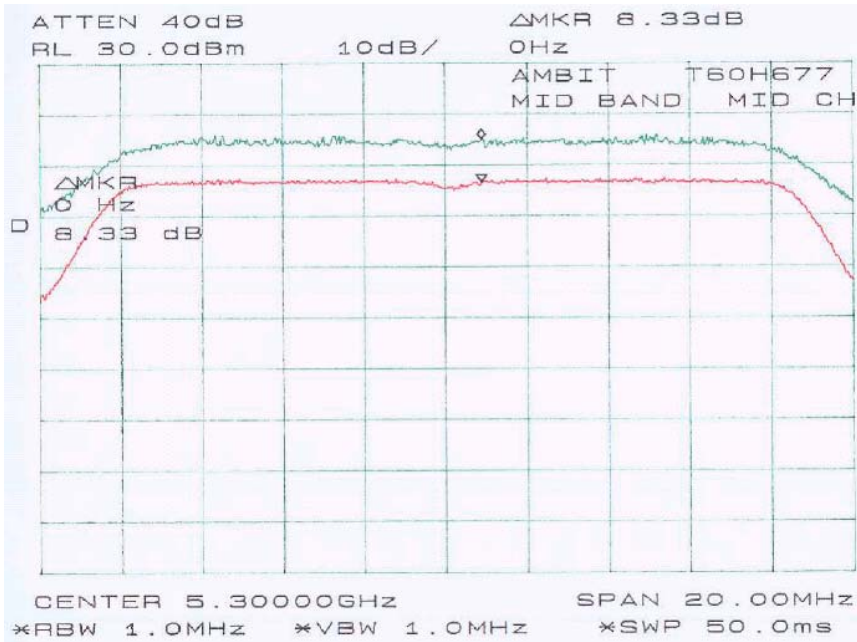
Band	Channel	Frequency (MHz)	Reading (dB)	Limit (dBm)	Result
Low	Low	5150	8.00	13	Compliant
	Mid	5200	7.66	13	Compliant
	High	5250	8.84	13	Compliant
Mid	Low	5250	8.50	13	Compliant
	Mid	5300	8.33	13	Compliant
	High	5330	8.00	13	Compliant
High	Low	5745	7.17	13	Compliant
	Mid	5775	7.17	13	Compliant
	High	5810	6.84	13	Compliant

Please see the hereinafter plots for more detail.

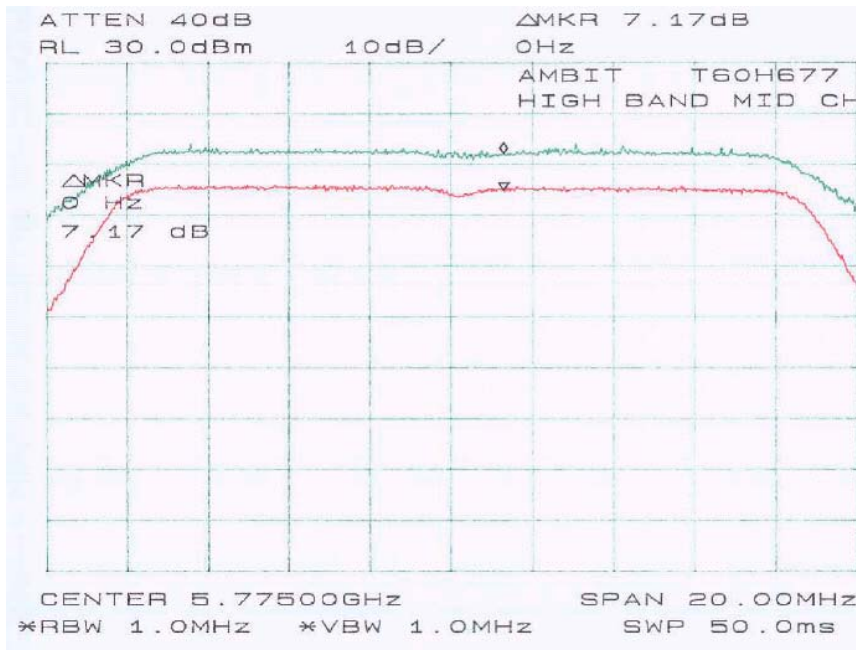
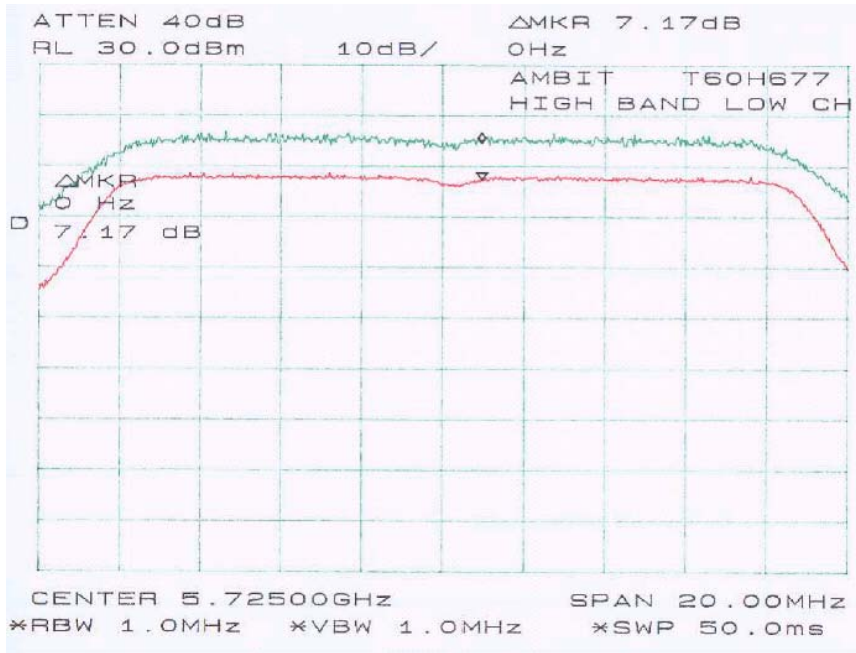


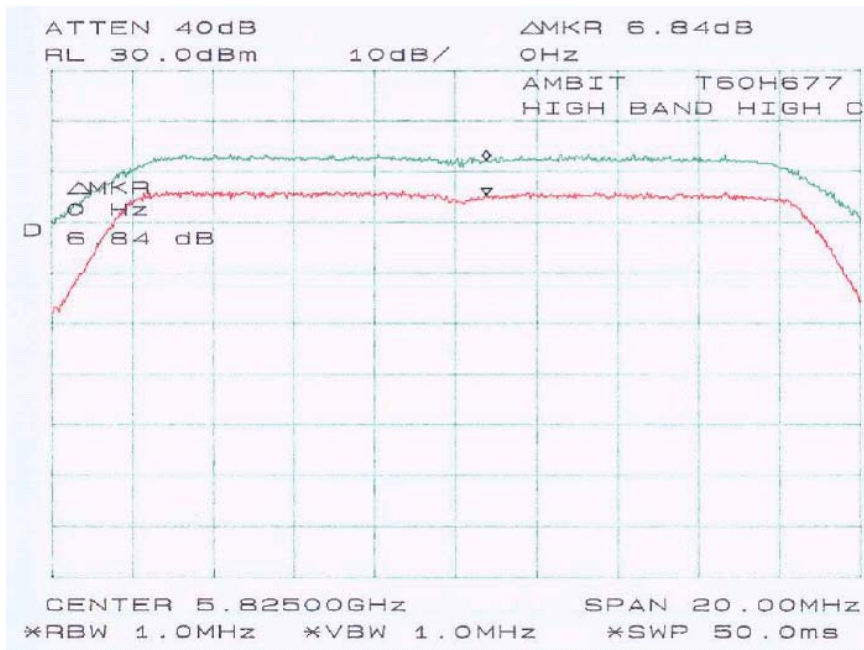












## §15.407(b) - Out Of Band Emission

### Standard Applicable

§15.407 (b), undesirable emission limits: except as shown in paragraph (b)(6) of this section, the peak emission outside of the frequency bands of operation shall be attenuated in accordance with the following limits:

§15.407 (b)(1), for transmitters operating in the 5.15-5.25 GHz band: all emissions outside of the 5.15-5.35 GHz band shall not exceed an EIRP of -27 dBm/MHz.

§15.407 (b)(2), for transmitters operating in the 5.25 – 5.35 GHz band: all emissions outside of the 5.15 – 5.25 GHz band shall not exceed an EIRP of -27 dBm/MHz. Devices operating in the 5.25 – 5.35 GHz band that generate emissions in the 5.15 – 5.25 GHz band must meet all applicable technical requirements for operation in the 5.15 – 5.25 GHz band (including indoor use) or alternatively meet an out-of-band emission EIRP limit of -27 dBm/MHz in the 5.15 – 5.25 GHz band.

§15.407 (b)(3), for transmitters operating in the 5.725 – 5.825 GHz band: all emissions within the frequency range from the band edge to 10 MHz above or below the band edge shall not exceed an EURP of -17dBm/MHz; for frequencies 10 MHz or greater above or below the band edge, emission shall not exceed an EIRP of -27 dBm/MHz.

### Test Procedure

For this test, the EUT’s antenna was removed and replaced with a low loss cable, so output power levels were calculated from conducted emission levels.

The analyzer center frequency was set to the EUT carrier frequency. The analyzer resolution and video bandwidth were set to 1MHz. The entire band from 30kHz to 40GHz was investigated.

Every suspected signal was also investigated through radiated emission. Refer to section 15.205 restricted bands of operation.

### Equipment Lists

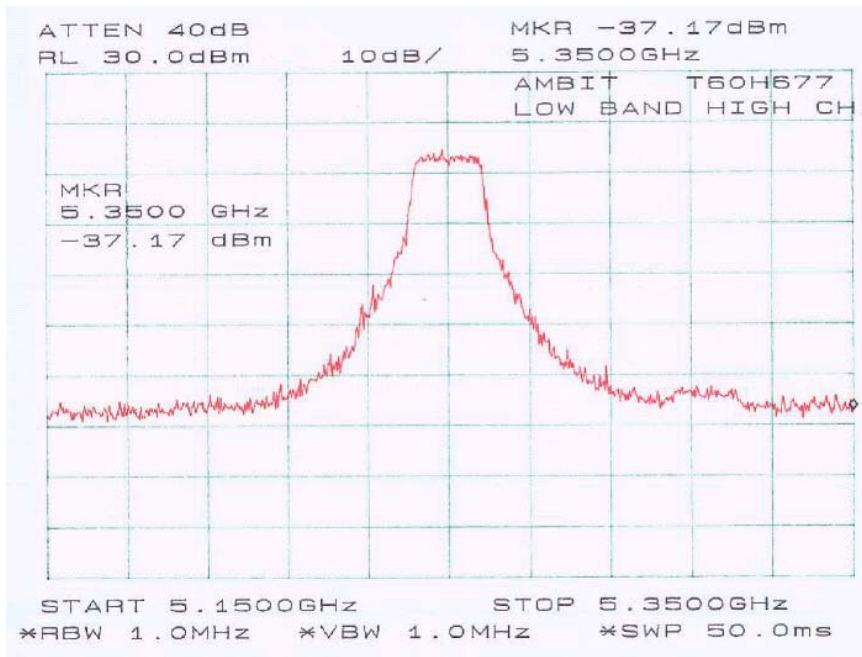
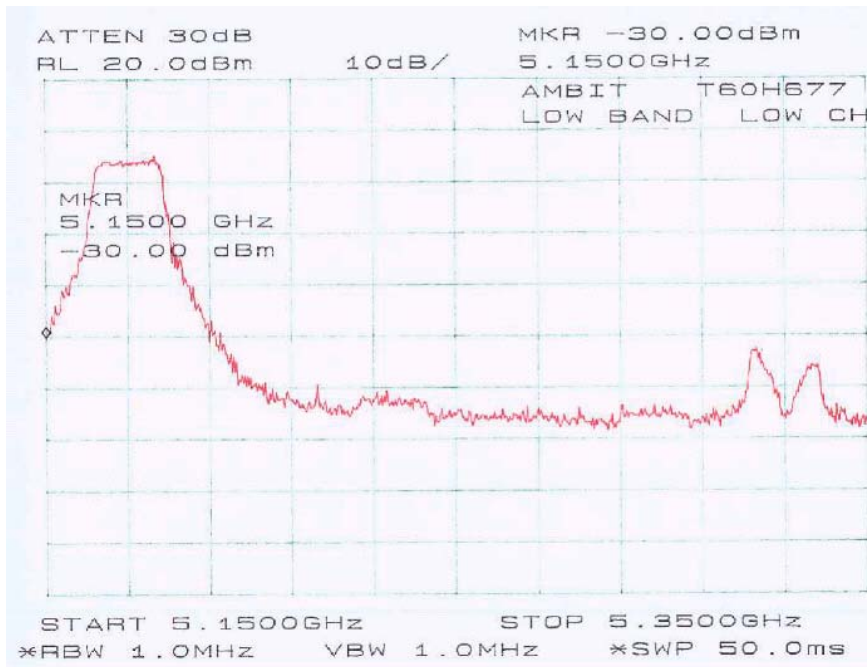
Manufacturer	Model No.	Description	Calibration Date
Agilent	8564E	Spectrum Analyzer	2003-08-26

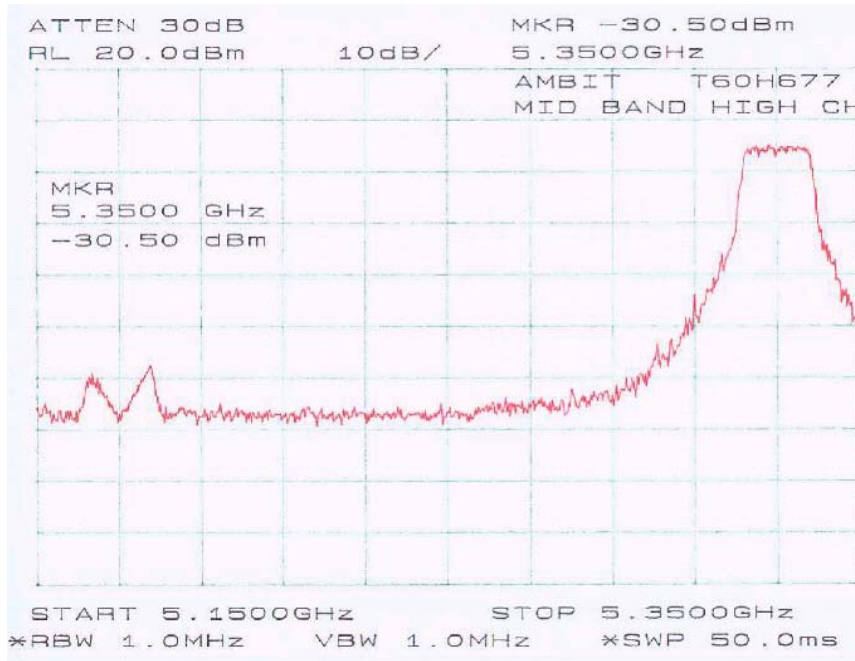
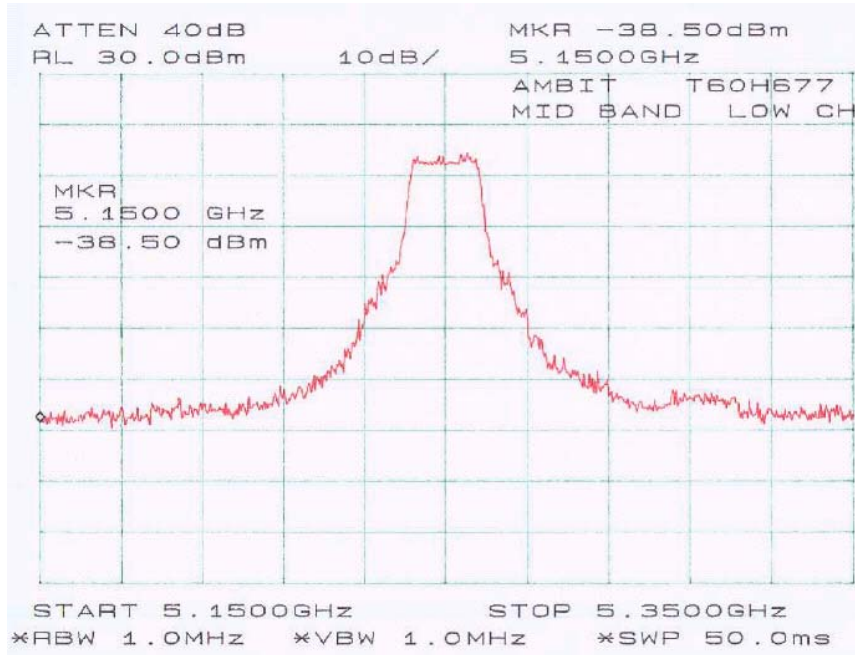
### Test Result

#### Environmental Conditions

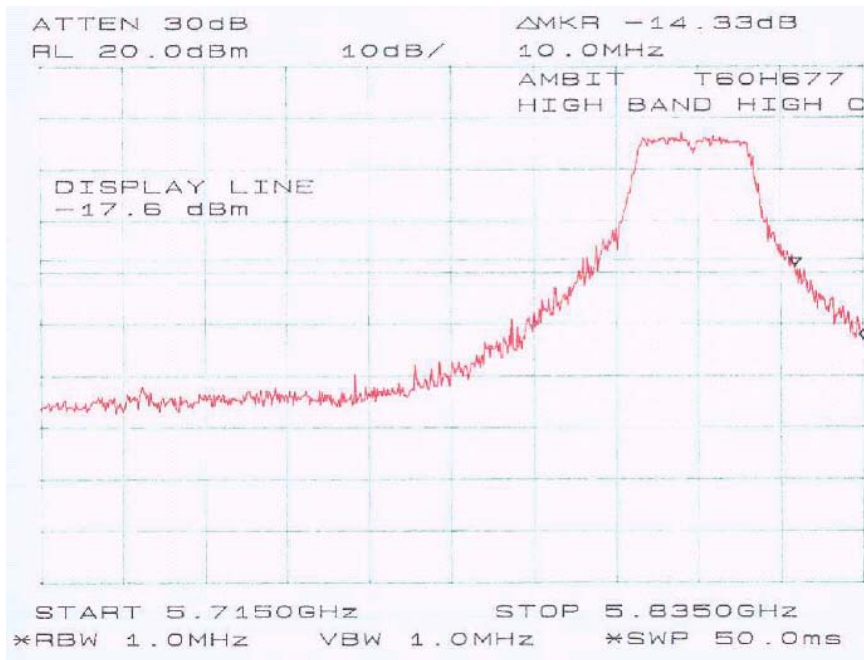
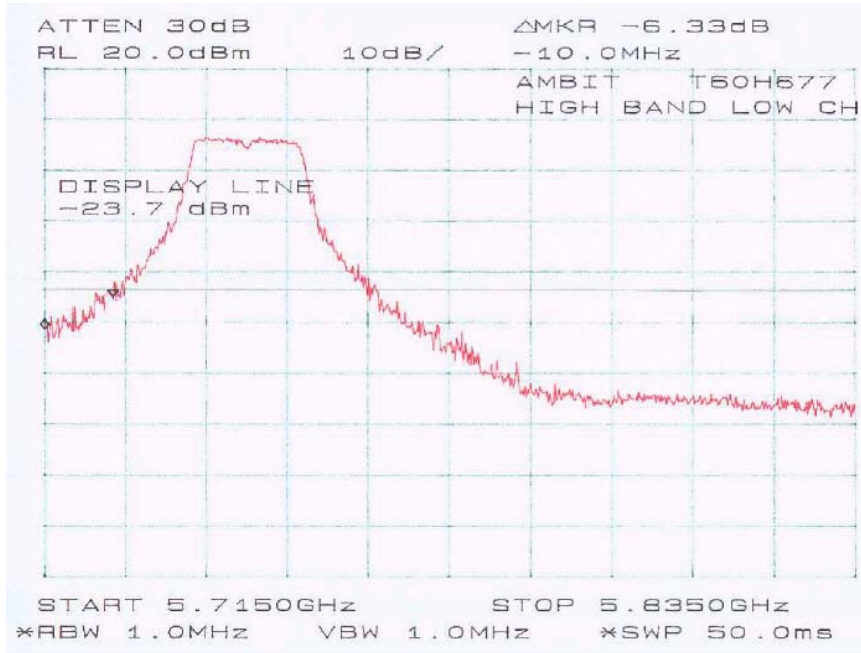
Temperature:	12° C
Relative Humidity:	48%
ATM Pressure:	1100 mbar

Please refer to the following plots.











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**15.407(c) - Discontinue Transmitting With Absence Of Data Or Operational Failure**

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According to § 15.407 (c), the device shall automatically discontinue transmission in case of either absence of information to transmit or operational failure. These provisions are not intended to preclude the transmission of control or signaling information or the user of repetitive codes used by certain digital technologies to complete frame or burst intervals. Applicants shall include in their application a description of how this requirement is met.

Please refer to respective technical description.

## §15.407(g) - Frequency Stability

### Standard Applicable

According to §15.407 (g), manufacturers of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation .

### Measurement Result

#### Environmental Conditions

Temperature:	12° C
Relative Humidity:	48%
ATM Pressure:	1100 mbar

Please refer to the following plots.

